The Chemical Age

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Contents

NOTICES:—All communications relating to editorial matter should be addressed to the Editor, who will be pleased to consider articles or contributions dealing with modern chemical developments or suggestions bearing upon the advancement of the chemical industry in this country. Communications relating to advertisements or general matters should be addressed to the Manager.

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Chemistry and Tanning

THE tanning industry and the growing industries dependent on it, to which special attention is directed in this issue, illustrate most convincingly the revolution which the application of chemistry may bring about in an industry in the course of a single generation. The tanning of hides for clothing and other purposes goes back, in its crudest forms, to very primitive times; the development of the modern chemical science of tanning, replacing the older alum and vegetable processes, falls well within the past half century. The results of this application of chemistry include an immense saving of time in the processes, the possibility of utilising a much wider variety of raw materials, a steady improvement in the quality and a far greater range of finished products, more economical as well as much more rapid production, and finally an enormously wider distribution of goods for personal, domestic, and industrial uses. Here, in fact, in this one field is to be found the whole moral of the application of science to industry.

Of the connection between the chemical industry and the tanning industry—the supply of essential materials, plant, etc. by the one for the other—particulars may be found in the various notices published in this issue. The service, however, already goes far beyond the chemical treatment of animal hides and similar raw materials as found in nature. Of particular interest is Dr. W. J. Jenkins's article on the manufacture of artificial or synthetic leather, more especially by the nitrocellulose process, though that is not the only one. After reviewing the remarkable progress made, he confidently predicts that in time artificial leather will be produced superior to natural leather in many ways, and that if progress continues on right lines unlimited applications will be found for it. For the moment we shall not rush in in front of the angels to determine the relative merits of the natural or the synthetic article. It is enough to say that the older methods of treating natural materials have been improved out of recognition by the application of chemical science and technology, and that, as in the artificial silk industry, we may even succeed in teaching nature a point or two.

America and Synthetic Methanol

OUR remarks in these columns some few weeks ago in connection with the synthetic production of methanol have led to inquiries which seem to indicate that interest in this substance and its production *via* water gas is by no means lacking in this country. At the time we were dealing primarily with the investigations which have been undertaken by M. Patart, whose first patent (French Pat. No. 540,343) was filed as far back as 1921. For the benefit of those of our readers who have inquired we may mention that the small industrial plant which is now operating on this process in France is in the works of the Oxylite Company at Asnières, near Paris. A much larger unit is, however, understood to be in the course of erection at the Toulouse Powder Works.

The situation in connection with synthetic methanol is particularly interesting from the point of view of this country. As the process relies on the production of water gas and, therefore, on a raw material which we have in plenty, there are grounds for supposing that it might quite possibly in the course of time become a contributory factor towards the alleviation of our oil fuel problems. The outstanding point in favour of the process is the contention that it is far more simple to conduct than is the Haber synthetic ammonia process, so that having mastered and improved upon the latter there would seem to be no technical difficulties concerning the former. It was, however, Fischer, we think, who pointed out that while the technical difficulties of deriving liquid products from water gas are, without doubt, less formidable than those of the ammonia process, the water gas process is much more complex in regard to the products obtained. For instance, the two components of the Haber reaction yield only one product—ammonia,

whereas in the water gas process the three components —carbon, hydrogen and oxygen—may give, perhaps, a hundred different compounds. The stumbling-block would, accordingly, seem to be that one might not ultimately obtain the precise compound desired.

Meanwhile, the production of synthetic methanol appears to be going on smoothly in Germany as a normal industrial operation, and its export to America is causing something of a stir in the wood distillation industry there. There appears to be some sort of agreement between the German manufacturers and the American wood distillers that the synthetic material shall not be put on to the American market at a price that will put the wood distillers out of business. Up to the present the American industry has not felt the full force of this outside competition, but an idea of what it will have to contend with may be gathered from the fact that in the first four months of this year some 150,000 gallons of methanol found their way into the country. It is said that quite a number of the American wood distillation plants have already shut down, and although the German methanol is so far no more than a potential danger, the American producers are already urging that more effective protective measures should be introduced before there is a repetition of the old, old story of foreign competition killing a home industry and then recouping itself by selling at fancy prices. The remedy lies, of course, in the promotion of a home synthetic industry, but it is fully realised that the time is remote when the whole of a country's needs can be supplied in this way, and in the interval the damage to the existing industry may be done. Meanwhile, it is pointed out that, so far as the market in all countries is concerned, the use of methanol for the denaturation of ethyl alcohol, the methylation of organic compounds, the synthesis of dimethylaniline and its derivatives, and the manufacture of formaldehyde and methyl esters, constitutes a growing demand, the formaldehyde required for the manufacture of synthetic resins alone constituting a market of several thousand tons annually.

Colour Users' Problems

THE annual report of the Colour Users' Association is notable for several of the problems it deals with, but more significant still for its silence on one point. There is no criticism of the principle of admitting foreign dyestuffs into this country under licence; that appears to be now accepted. The only criticism relates to details in the administration of the system, and even here it is admitted that, generally speaking, the applications for licences have been dealt with very expeditiously. The Council's reference to the Dyestuffs Development Committee raises questions of a far more fundamental character than any the Licensing Committee deal with. The Council is not "entirely satisfied" that the Development Committee is tackling the problem of the efficient and economical development of the dye-making industry in a manner likely to achieve good results. This, though the language is mild, is severe as a judgment. The condition had been partly recognised already by the appointment of a sub-committee of dye manufacturers; it was further recognised in the recent addition to the Development Committee of Dr. E. F. Armstrong and Mr. Sutcliffe Smith. The Development Committee is not to be blamed; nor, indeed, does anyone blame it. Only now is the way becoming clear for that co-operative action among all dyemakers which is essential to a collective advance, and it was preferable to wait until the lines of a sound policy began to emerge rather than to attempt hasty experiments which might have to be followed by retreat. The conditions of the industry are now more favourable than at any previous stage for considering a definite development scheme, and there are signs that the Committee is quite alive to the situation.

The other main question, from the users' point of view, is price; quality and supplies are no longer in question. The claim that the price factor should be reduced from three times pre-war to two-and-a-half pre-war in consequence of the recent decline in raw material costs has been accepted in principle, subject to certain stabilisation provisions. That, so far, is satisfactory. In regard, however, to the British makers' prices of indigo 20 per cent. paste, as compared with German, Swiss, and American prices, the position is described as "very acute," and the users obviously feel that some modification is urgently needed, for they go so far as to suggest that the high charges for indigo may explain the shrinkage in the output of indigo prints. The only other point that calls for mention is the Council's opinion that the dyestuffs statistics now published relating to production, export, and import are inadequate, and that the Board of Trade might with advantage follow the United States practice. Here, we imagine, every interest will be with them, for nothing but good can result from fuller information.

Conferences for Technicians

MR. GEO. A. SMY, a well-known chemical engineer, makes in this issue what we regard as a practical and most useful suggestion, namely, that there is much too little conference among leaders of the heavy chemical industry on the technical and economic aspects of their work, and that this defect can only be removed by periodical meetings for discussion and the interchange of views and experience. Of the advantage of this method, perhaps the best example is found in the conferences of the Chemical Engineering Group, whose members periodically meet for this purpose, and whose common knowledge of the problems in which they are all interested has been appreciably enlarged.

Mr. Smy particularly mentions the case of sulphuric acid manufacture. The technical men in charge of the works are constantly coming up against little troubles, which they have to tackle alone. Exactly the same or similar points may be troubling their colleagues in other works. By a friendly consultation among themselves they would be much more likely to discover what is wrong than by working in isolation, and when a solution is reached no single firm would be any the poorer, but the practice of all would be advanced a point and the whole industry benefited. It is not easy to see what objection can be raised to Mr. Smy's suggestion that area conferences on these lines would prove of great advantage to all concerned. The views of other chemical engineers and works managers would be distinctly interesting.

A Blow to Profit Sharing

A BLOW which may be serious has been struck at the principles of profit-sharing and co-partnership by the decision of Mr. Justice Rowlatt in the case of the Taxing Authorities *v.* the Hon. Sir Charles Parsons. In connection with his company, C. A. Parsons and Co., Ltd., Sir Charles has, it appears, inaugurated a co-partnership scheme on somewhat original lines. He has set aside for the benefit of employees a big block of shares in the company, providing by deed that the dividend on those shares should be applied to the purchase of them. Instead of taking the whole of the dividend as his own income, Sir Charles earmarked a portion of it to form a capital fund which when accumulated would belong to leading employees of the company. The Collectors of Inland Revenue, however, took the view that this money, although applied to these purposes, was still part of Sir Charles Parsons' income and assessed it to income tax and super-tax. The Commissioners, before whom an appeal was taken, took the opposite view and held that the dividends were subject to a binding trust in favour of the employees, and that they did not form part of the respondent's income for the purpose of assessment to super-tax, and they therefore discharged the assessment.

From that decision the Crown appealed, and Mr. Justice Rowlatt held that the dividends as they accrue cannot be other than dividends of the respondent, although he might be under obligations with regard to their disposal in the future. He therefore gave judgment for the Crown and there for the moment the case ends. The decision, therefore, is that a well-meaning employer desiring to pass an interest in his business into the hands of those who are working for him, is debarred from so doing unless he will add to his other benefactions the full amount of taxation upon the sum of his gifts. The decision, of course, applies only to the special case of C. A. Parsons and Co., Ltd., but it cannot fail to have a discouraging effect upon others contemplating profit-sharing schemes.

Faraday Conference at Oxford

THE "General Discussions" organised by the Faraday Society on specially selected subjects have served a valuable purpose in registering from time to time in a compressed and convenient form the current level of knowledge in various branches of research. For the "General Discussion" which the Society is arranging at Oxford in October 1 and 2 next, the subject of "Photo-chemical reactions in liquids and gases" has been chosen and will be discussed under two main heads: (1) "Einstein's Law of Photochemical equivalence," and (2) "The Mechanism of Photochemical Reactions." Part I will be opened by Professor A. J. Allmand (King's College), and Part II by Professor M. Bodenstein (Berlin). In addition to the leading English workers on photochemical action, many distinguished investigators from the Continent and America have signified their intention of taking part in the proceedings, and an attractive programme of papers has been prepared. It is hoped to accommodate all who attend the meeting at Exeter College and Lincoln College. Non-members of the Faraday Society may attend the meeting, and those desirous of doing so are invited to communicate at once with the Secretary of the Faraday Society at 90, Great Russell Street, London, W.C.1, from whom full particulars may be obtained.

New Celatene Colours

WE have received from Scottish Dyes, Ltd., an interesting folder illustrating their Celatene colours on acetyl silk. These, of course, are not existing colours which have been modified for use with acetyl silk, but are a new series of anthraquinone derivatives specially synthesised for the purpose. These Celatene colours do not dye cotton and they are not recommended for wool mixtures, but they can be used to produce beautiful two-colour effects on mixed acetyl silk and viscose or cotton colours. These effects can be obtained by a one-bath process if the viscose is coloured with direct dyes, but to get parallel fastness in the two fibres vat colours are recommended, and these require two baths. The examples include an extremely delicate effect obtained with Caledon Jade Green and Celatene Orange and a peculiarly rich and soft effect with Caledon Blue RC and Celatene Red Violet. A pattern card of dyed shades on Celanese shows eleven Celatene colours ranging from Fast Light Yellow to Black.

Points from Our News Pages

A special article by Dr. W. J. Jenkins on artificial leather with reference to its manufacture from Nitrocellulose (p. 628).

A symposium on Chemicals used in the tanning industry contributed by leading firms (p. 630).

"Synthetic Methyl Alcohol Production," by R. T. Elworthy (p. 634).

British Colour Users and Dyestuff Problems—Review of the year's work of the Colour Users' Association (p. 635).

Letters are published on "Chemical Industry Conference" (G. A. Smy) and "The Manufacture of Salvarsan (Burroughs Wellcome and Co.) (p. 633).

The death is announced of Senator Ladd, Mr. A. Seymour Jones, Mr. R. Sugden and Mr. G. L. Gooden (p. 638).

Our London market report shows trade generally better with prices steady. Export demand, although patchy, is quite active in parts (p. 643).

The Scottish market is quiet with no marked changes (p. 646).

Books Received

A SYSTEM OF PHYSICAL CHEMISTRY. Vol. II. By William C. McC. Lewis. London: Longmans, Green and Co. Pp. 490. 15s.

ORGANIC DERIVATIVES OF ANTIMONY. By Walter G. Christiansen. New York: The Chemical Catalog Co. Pp. 230. $3.00.

BASE EXCHANGE IN SOILS. A General Discussion held by the Faraday Society. London: The Faraday Society. Pp. 68. 5s.

THE PHYSICAL CHEMISTRY OF IGNEOUS ROCK FORMATION. A General Discussion held by the Faraday Society, the Geological Society, and the Mineralogical Society. London: The Faraday Society. Pp. 96. 6s. 6d.

The Calendar

1925 July 9	Mond Nickel Co., Ltd.: Twenty-fifth Anniversary Dinner. 7.45 p.m.	Savoy Hotel, London.
13 to 18	Society of Chemical Industry: Annual Meeting.	Leeds.
Aug. 26 to Sept 2	British Association for the Advancement of Science.	Southampton.

Artificial Leather: With Special Reference to Its Manufacture from Nitrocellulose

By W. J. Jenkins, Ph.D., B.Sc.

The author gives a clear and simple description of artificial leather manufacture, more especially by the nitrocellulose process. In view of the steady progress which is being made, he confidently predicts that in a few years artificial leather will be produced superior to natural leather in most respects, and that if the improvement in the material progresses in the right direction unlimited applications will be found for leather substitutes.

THE artificial leather industry had its beginning in England early in the nineteenth century. During the last twenty years, however, more progress has been made than in the whole of the previous century. The needs of the automobile makers have been the chief stimulant which has brought about this change.

Different types of artificial leather are now produced in huge quantities. Some of these have very little resemblance to leather, but a few of them approach the natural material in their flexibility, resistance to wear, and elasticity. The leather substitutes manufactured from cellulose xanthate, rubber compounds, cellulose acetate, and nitrocellulose are the most successful.

The product made from cellulose xanthate or viscose has not proved entirely satisfactory. It is not very resistant to wear nor does it possess suitable elasticity. Attempts have been made to improve its properties by the addition of thermoplastic agents and by a final coating of rubber or gutta percha.

The substitute manufactured from rubber compounds consists of leather refuse ground into a fine powder and incorporated thoroughly in rubber solutions containing volatile solvents. These ingredients are worked together, rolled into

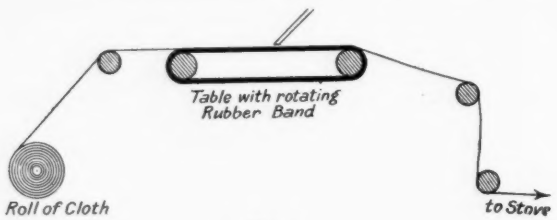

FIG. 1.

thin sheets, and then spread as a paste on a suitable cloth. Each coat is dried and is then covered again, and so on until the requisite thickness has been obtained. Every second or third coat is vulcanised. This type of product is generally used as a floor covering.

The best artificial leathers are unquestionably those made from cellulose acetate and nitrocellulose. The manufacture of the former kind has been developed more highly in the United States than in this country. Nitrocellulose (pyroxylin or cellulose nitrate) artificial leather is superior to all others at present and closely resembles the natural product in many of its qualities. In general, the manufacture of this substitute is relatively simple and is as follows :—

A suitable fabric, prepared in various ways and wound in rolls, is coated with a pigmented paste of nitrocellulose. This paste, usually termed the dope, is obtained by dissolving the nitrocellulose in a mixture of acetone, benzene, and alcohol and afterwards working in the necessary quantities of pigment and castor oil. The coated cloth is dried by stoving and is then re-wound for further coating. This process is continued until the required thickness of material is produced, and sometimes a final coating of transparent nitrocellulose solution is put on so as to give a lacquered surface. The dried cloth is then embossed to imitate the skins of animals or to give it a desirable pattern. A fuller description of each step in the manufacture is given below.

Choice and Preparation of the Cloth

Careful attention has to be paid to the choice of the fabric, for the quality of the finished material depends on it to a marked extent. For instance, if the mesh is not small the paste passes through and gives the under surface a patchy appearance. The most suitable fabrics are duck, twill, drill, moleskin, and lawn. Duck is used for the strongest leathers, for the warp and weft are of the same material. The cloth is usually dyed with direct cotton colours so as to improve the appearance of the finished leather. Sometimes the fabric is napped and felted to give the leather a woolly feel and also to strengthen the anchorage of the dope.

For certain qualities of artificial leather the cloth is backed so as to add to the strength and wearing qualities and also to improve the appearance of the underside. The backing material or " cooked mass " is usually made from a mixture of china clay, starch, glue, soda ash, benzene, linseed oil, and driers. A suspension of the clay in water is added to a jelly of boiled starch, which is then mixed with a solution of the glue. The soda ash, linseed oil, and driers are added in the proportions necessary to give a suitable homogeneous mass after stirring for several hours at a high temperature ; this is generally done in a steam jacketed pan. The process of spreading the " cooked mass " on the cloth is the same as that described below for the dope under " Spreading and Stoving." It is necessary to dry the cloth by stoving it for several hours at a comparatively high temperature.

Careful rewinding of the cloth into rolls is next done so that it can run evenly on the table of the spreading machine

Preparation of the Dope

The composition of the paste varies considerably with different manufacturers. Some use celluloid and cinema film scrap, but the highest grade of material can be obtained only by the use of specially prepared nitrocellulose. The most important physical property which regulates the kind of nitrocellulose that may be used is its plasticity, for on this depends the ease with which the dope spreads and also the optimum thickness of each layer that can be applied. A suitable cellulose nitrate has been obtained only after a great deal of investigation, and its manufacture depends on the experience gained in the production of nitrocotton for the explosive industry.

In the table given below are the compositions of four typical nitrocellulose solutions used in the artificial leather industry. There are many other similar formulæ, for each manufacturer chooses the proportion of each ingredient to suit his own purposes.

The composition of Typical Solutions used for the Manufacture of Artificial Leather from Nitrocellulose :

Parts by weight of.	Dry Nitro-cotton.	Acetone.	Ethyl Acetate.	Alcohol.	Benzene.
A	20	53	—	18	9
B	20	50	—	24	6
C	20	45	5	24	6
D	20	—	32	24	24

The acetone-alcohol-benzene mixtures are the most economical solvents for nitrocellulose, but it is sometimes found advantageous to replace a portion of the acetone by a higher boiling solvent such as ethyl acetate to prevent the " blushing " or " blooming " of the coating during damp weather. Occasionally the whole of the acetone is replaced by ethyl acetate, but as this is a more expensive medium its use is kept at a minimum.

When the nitrocellulose has been added to the solvent, the mixture is allowed to mature for several hours in a closed vessel, and is then transferred into an incorporating machine. To the homogeneous solution or jelly thus obtained the pigments are added.

A variety of pigments are used—ochres, chrome, siennas, bone black, prussian blue, ultramarine blue, lake colours, lithopone, etc. The pigments must be chemically inert and the lake colours must be insoluble in the solvents

used, otherwise bleeding takes place. It is necessary to grind the pigments in a paint roller mill in the presence of a non-drying or semi-drying oil, such as castor oil, which acts as a lubricant at this stage.

No very definite limits are fixed for the amount of pigment to be used in the dope, but an average proportion is two parts of pigment, in half its weight of castor oil, to every three parts of nitrocllеulose. This proportion varies with the density of colour desired and with the covering qualities of the pigment. Castor oil is now added until there are about three parts of it for every two parts of nitrocellulose. Since the chief function of the castor oil is to induce softness in the leather, no undue importance can be given to this ratio, for it has to be varied with the degree of softness desired in the material. The consistency of the dope depends to a large extent on the amount of pigment and of castor oil which it contains, and it is customary to adjust this by thinning down with industrial spirit. For the cheaper qualities of leather substitutes celluloid scrap is used to replace about half of the nitrocellulose, though some products contain a far higher proportion of celluloid scrap.

Spreading and Stoving

The coating or spreading is done on a table formed by stretching a sheet of rubber as a belt round two parallel rollers so as to give a flat surface. Over this revolving table the cloth is drawn so that it lies evenly on the surface and just clears a knife fixed at right angles to it as shown in Fig. 1. The dope is fed at a constant rate on to the cloth, and by adjusting the clearance and the inclination of the knife a smooth coating of nitrocellulose is obtained. There are several factors regulating the thickness of the coat. Of these the most important are the plasticity of the dope, the clearance between the knife and the cloth, and the speed at which the cloth is carried. The adjustment of these factors to give a suitable leather surface requires much experience and ingenuity.

From the spreading table the cloth is drawn directly into a high stove where the manner of drying depends on whether or not the solvents are recovered. The solvents evaporate readily at room temperature, except in cold weather, when it becomes necessary to warm the stove by means of protected steam pipes laid along the floor. Usually the stoving takes about twenty minutes. The cloth is then calendered and stretched and coated again, the process being repeated until a material of the requisite quality has been prepared. The number of coatings applied depends on the quality of the material required, and varies from three to twenty.

When an artificial leather with a glossy surface is needed the dried cloth is coated with a clear dope of nitrocellulose, slightly less viscous than the one used for the earlier coats, and containing very little castor oil and no pigment. The final stoving is carried out at a slightly higher temperature than the previous ones.

A grained pattern is given to the surface of the artificial leather by passing it between two hot rollers or plates. Usually one roller or one plate is made of steel embossed with the pattern, while the other is made of rubber to prevent the steel from cutting the cloth.

It is customary to work two or three spreading machines side by side, and to draw off the cloth into the same stove. This is a practice which is not encouraged, for the danger risk from fire is greatly increased, although every precaution is taken to make the stove fireproof. Occasional fires happen, but on the whole the industry has been markedly free from serious outbreaks.

Future Developments

The highest grade of substitute made in this manner from nitrocellulose resembles leather very closely in most of its properties; the main difference lies in its lower resistance to abrasion. In this respect artificial leather is being gradually improved, and there seems little doubt that in a few years it will be produced superior to natural leather in most respects.

There is room for unlimited application for leather substitutes provided that the improvement in the material progresses in the proper direction. Since cellulose nitrate is its most important raw material, the industry is fortunate in being able to make use of the improvements made in the manufacture of nitro-cellulose for explosives. There is, however, a number of problems which the artificial leather manufacturers have to attack directly. The ones which need immediate investigation are the use of optimum solvents for the dope and the application of new plastifying agents. The former requires not so much the discovery of new solvents as an examination of the manner in which the known ones can be combined to give the most economical and satisfactory mixture. With regard to plastifying agents careful research is necessary, for the mechanism underlying plasticity is not clear, but the progress made in colloid chemistry during the present time should prove very helpful in this matter.

The most obvious direction in which the leather manufacturer can reduce the cost of production is by the recovery of the solvent used. This is a problem which the chemist has already worked out satisfactorily. Attempts have been made on an industrial scale to recover the alcohol and acetone by drawing the air from the mixing room and the stove through water, but these have proved to be impracticable. A more suitable method is to use adsorbents such as silica gel and activated charcoal. Other industries have used these satisfactorily for similar purposes, and there is every reason to believe that they will be equally efficient for the recovery of acetone and alcohol.

Boric Acid in Chemical-Resisting Glass

Paper before the Society of Glass Technologists

THE final meeting of the 1924-25 session of the Society of Glass Technology was held at University College, London, on Wednesday, Mr. T. C. Moorshead (president) in the chair.

The first paper, on "An Attempt to Improve the Qualities of Glass intended for Lamp-working Purposes," was presented by Professor W. E. S. TURNER (head of the Department of Glass Technology, Sheffield University) on behalf of a Joint Committee of the Glass Research Association. The paper embodied a general report prepared by Mr. F. F. S. Bryson (Secretary of the Glass Research Association) from reports sent in by manufacturers on the working of glass samples sent to them. The results of the tests appeared to show that the glasses prepared for the Glass Research Association were good, and in several cases better than the glass at present used. The consensus of opinion was that the two glasses with the following composition (by analysis) were the best:—

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	B_2O_3	Total	Total K_2O & Na_2O
66·74	5·48	0·07	6·16	1·18	5·10	14·60	0·40	99·73	19·70
68·16	4·27	0·06	6·48	0·71	5·32	14·57	0·22	99·79	19·89

The results were sufficiently satisfactory to justify the manufacture on a commercial scale of these two glasses.

Boric Oxide in Chemical-Resisting Glasses

The next paper, on "A Study of the Influence of Boric Oxide on the Properties of a Glass intended for Chemical Resistance Purposes," was by Professor TURNER and Mr. F. WINKS. Professor Turner said that boric oxide was a constituent which became of great importance in connection with optical glass in the last quarter of last century, and this was followed by the use of boric oxide in glass used for chemical work and for illuminating purposes. It had been found generally that the introduction of boric oxide reduced the thermal expansion of the glass and also increased the durability of a glass, certainly against the action of water and neutral solutions and, to a certain extent, against acids. It was found from tests that the use of boric oxide had very definite limitations, and that when the amount of boric oxide added to the glass was beyond a certain percentage its value began to disappear and was, in some proportions, exceedingly detrimental. He had had selected for testing Kavalier's well-known chemical glassware, which contained silica, lime, soda and potash, and very little alumina.

Tests showed that the maximum advantage was obtained with between 11 and 14 per cent. of boric oxide and, in the case of the more complicated glasses, between 10·6 and 13·6 per cent.

Mr. E. A. COAD PRYOR said the paper seemed to suggest that the real value of boric oxide was that it resulted in a glass which was more easy to melt and in which, therefore, the alkali content could be reduced.

Professor TURNER replied that he was not able to judge by the experiments the effect of boric oxide in comparison with the effect of alkalis, but it was a conclusion which would seem to be warranted, except that there was a very definite limit to the use of boric oxide.

Chemicals Used in the Tanning Industry

What British Firms are Producing

We give below notes kindly supplied by various chemical companies relating to chemical products and plant used in the tanning industry.

Charles Tennant and Co.

Chemicals for Heavy Leather Manufacture

MODERN tannages of heavy leather call for the use of a larger variety of chemicals than is generally realised. Whereas, in the old days, a tanner of heavy leather could produce a saleable and profitable article using only LIME in the beamhouse for loosening hair and for getting the goods plumped in readiness for the acid tanning liquors, only one or perhaps two or three tan barks or other vegetable tan-containing products for the actual tanning, and only COD OIL or Cod and LINSEED OILS in the finishing, to-day, in order to eliminate waste, to shorten and to produce profitably that which is required, he has to resort to many a chemical aid.

To a modern sole leather tanner SODIUM SULPHIDE is almost indispensable. By its use in conjunction with lime the loosening of the hair can be greatly expedited, while, if he tans dry hides, it is even more useful in enabling him to soften quickly without the loss of hide substance occurring in connection with the old slow water-soaking process. CAUSTIC SODA is often used in conjunction with lime and sodium sulphide in the liming process as an additional aid for plumping. It is also used as an aid to the soaking of dry hides.

It would not be feasible for large modern tanners to buy the large quantities of natural tan-containing vegetable products necessary for his tanning requirements and to prepare from them liquors of the required strength. Instead, he buys extracts of these materials in solid or heavy liquid forms, buying natural products, if at all, in smallest possible quantities. The most generally used of these extracts are QUEBRACHO, CHESTNUT, MYRABOLANE, MIMOSA, MANGROVE, OAK, VALONIA and GAMBIER. Liquors of these extracts not being so readily fermentable as the liquors used in the older process, and the length of tannage being considerably shorter, the modern tanner has to resort to artificial acids in order to retain plumpness of his goods during tannage. SULPHURIC ACID is often used in regulated quantities for this purpose, while LACTIC, SULPHUROUS, and ACETIC ACIDS are sometimes favoured as being safer. As a preliminary bath, before the goods are put into the tanning liquors, BORIC ACID is often used. This serves to neutralise the surface of the goods and so to aid in the attainment of good colour.

In order to keep the tanning liquors soluble and thus eliminate precipitation waste, modern tanners use considerable quantities of BISULPHITE OF SODA or SULPHITE OF SODA, either as such or as constituents of the extracts.

When the leather is fully tanned it is impregnated with matters which are highly oxidisable. In order to overcome this oxidisability and so enable the leather to dry a good colour, a liquor prepared from SUMAC is sometimes used, with or without such further aids as iron-free SULPHATE OF ALUMINA, EPSOM SALTS, GLUCOSE, and OXALIC ACID. BORAX, being a very mild alkali, is also often used at this stage.

Before and during drying, oils are used, generally mixtures of MINERAL OIL, FISH OIL and SULPHONATED OIL, the proportion of these varying according to the requirements of the leather and to previous treatments.

The above mentioned chemicals are those commonly used in heavy vegetable tanning. Chrome tanning calls for quite a different category, BICHROMATE OF POTASH, BICHROMATE OF SODA and HYPOSULPHITE OF SODA still being the chief among those necessary for many such tannages.

Many leathers, after the tanning is completed, either by vegetable process or by chrome process, need some sort of grease, oil or wax filling in order to give them the requisite tensile strength and other qualities. Harness, belting, upper and most fancy leathers need such treatment. After such, many leathers need to be dyed and specially treated for fancy appearance. For black finished goods NIGROSINE is chiefly used, and for a wax PARAFFIN WAX is often a necessity. Other dyes and materials in general use for filling and dyeing are too numerous to be mentioned in this short survey.

United Alkali Co.

How the Needs of the Tanning Industry are Met

It may, perhaps, be justly claimed that there is not an industry in the United Kingdom which is not served to some extent by the products manufactured by the United Alkali Co., Ltd., at Widnes, Runcorn, St. Helens, Fleetwood, Glasgow, Newcastle-on-Tyne, Bristol, and London. The tanning industry certainly is no exception.

Sulphide of sodium, carbonate of soda, hyposulphite of soda, bisulphite of soda, acids, alkalis and salt are all products which have been manufactured in the works of this company for upwards of 100 years. Many of these were of no interest to the tanner at one time, but as the tanning industry has progressed and made increasing demands on the chemical manufacturer, so has its needs been met by the application of the standard products of the United Alkali Co., or by some special modification of one of those products.

A good example is furnished by sulphide of sodium. This was produced, though not isolated, as a stage in the old Leblanc Alkali process. When the need arose for it as a depilatory in tanning it was a simple matter, after the experience of many years of alkali manufacture, to modify the process and produce sodium sulphide in a form and of a degree of purity exactly suited to the demands of the leather industry. To-day, the Leblanc Alkali process, as a whole, is obsolete, but this particular section of it survives as a source of high-grade sodium sulphide, a product important alike to the dyer and to the tanner. The standard grades of sodium sulphide produced by the United Alkali Co. are solid concentrated, broken, flake—all 60/65 per cent., and crystals 31/34 per cent. This range of products covers the needs of all classes of work and process, and is sent out in an equally comprehensive range of packages. For soaking and softening dried hides and skins and as a dehairing agent this branch of sodium sulphide is particularly suitable, on account of its comparative freedom from iron and other objectionable matter.

The increasing use of tanning extracts has created a new demand for another product of the alkali industry. Bisulphite of soda, containing 20 per cent. and 25 per cent. SO_2 is now extensively needed for the preparation of "bisulphited" or "bleaching" extract. This product, together with carbonate of soda (soda ash and soda crystals), hyposulphite of soda and hydrochloric and sulphuric acids, finds a considerable application in mineral tanning. These are all supplied in the usual standard commercial grades, and are of the same uniform high quality as the United Alkali Co.'s sodium sulphide.

Mention should also be made of the use of acetic acid, sold in a range of strengths from 25 per cent. to 80 per cent., and also as glacial acetic acid, as a deliming and mild acidifying agent.

Carbonate of soda, apart from its use in chrome tanning processes, is of value as a washing agent and as an oil remover.

Lastly, the principal raw material of the alkali and heavy chemical industry is of considerable importance to the tanner. Common salt is employed in various ways in the tannery, finding, perhaps, its chief application as a preservative. Salt is produced in enormous quantities by the United Alkali Co. for their own use. A portion of their output is available for sale, and can be supplied in bulk or in bags, as required.

The United Alkali Co., on account of their widespread activities in Great Britain, the convenience of their works to the principal ports and centres of industry, and their numerous points of contact at all stages of their processes with the tanning industry, can serve and co-operate with those engaged in that industry. Thanks to the friendly relations prevailing between the company and the industry, this service and co-operation exists and grows.

Brotherton and Co., Ltd.

Some Notes on Their Synthetic Tannin

"Stannin" is a synthetic tannin, which is produced at Port Rainbow, the works of which Brotherton and Co., Ltd., of Leeds, the largest British distillers of phenols, are the proprietors. Stannin resembles the natural tannin derived from trees, and was first prepared in 1913 by Stiasny. It gives a pliable and tough leather almost white in colour, and protects the grain and fibre, so that it is eminently suitable for preliminary tannages which are to be followed by immersion of the goods in strong vegetable liquors and extracts. It has distinctive colouring properties, which are absent from the natural tannins, and by its aid the tanner of sole or heavy leather is enabled to use dark coloured tannins in proportions which would otherwise be impossible. Stannin claims to have advantages over synthetic tans made from crude phenols, cresols and naphthalenes, as the latter contain matters such as pyridine which have an undesirable effect on the leather.

The methods of using Stannin practised in the leading tanneries of the country are outlined in a pamphlet issued by Messrs. Brotherton, which describes their product and some of its applications. Pickled pelts tan especially well in a 5 per cent. solution of Stannin, although it is not necessary to prepare a special bath of this substance, an addition of up to 3 per cent. of Stannin to the drum, after pickling has been carried out for one hour, being all that is necessary. Penetration is very rapid, and it is possible to get a permanent tannage in a few hours.

While Stannin will not alone give very heavy weight in the tannage of heavy leathers, it can be used to plump the pelt and to speed the tannage, and used with other materials it will give good weight. Further, while the usual methods of bleaching sole leather are drastic and result in loss of weight, treatment with Stannin gives results without this loss.

John and James White, Ltd.

The Chrome Tanning Process

John and James White, Ltd., of Glasgow, were, for many years, the sole makers of bichromates, but ultimately the manufacture was begun on the Continent and later in America. Many tanners have been accustomed to buy Messrs. White's bichromates and manufacture a tanning liquor for themselves, but as these liquors are often of very uncertain strength, the results obtained with them are not so satisfactory as they would be if a uniform liquor of definite composition were used. To provide this for the tanners Messrs. White have produced a Chrometan which can be sold in a liquid form to those who are near their works, and in a crystalline or dried form to those who are distant. Both the liquor and the crystals have the same basicity, namely, 96, and the liquor contains 12½ per cent. and the crystals 25 per cent. of oxide of chromium. This product is easily dissolved in a tanning bath, and may confidently be recommended to tanners to give good results.

The object of tanning is to convert the animal skin into a permanent material, one that is not easily subject to decay. While a large proportion of leather is produced by means of vegetable tanning materials, most of which are imported from abroad, chrome tanning has of late years become of much greater importance, and especially was this the case during the war, when vegetable tans were scarce and difficult to obtain. Vegetable tanning is, moreover, a very slow process, usually extending over several months, while chrome tanning can be carried out within twenty-four hours. This latter fact was of great importance during the war, as it would have been quite impossible, by vegetable tanning alone, to turn out even sufficient leather to supply the needs of our own country. Millions of pairs of boots, worn during the war not only by our own troops, but by the French, Russians, and Italians as well, were, in fact, made from leather tanned by chrome compounds made within a few miles of Glasgow.

Chrome tanning is carried out by one of two methods, known as the one-bath and two-bath process respectively. In the one-bath process, the tanning agent used is a solution of a chromium salt, generally the sulphate. The tanning usually takes place in a large revolving drum, into which the prepared hides are put, along with the necessary quantity of chromium sulphate liquor, and the drumming is continued until the hides are fully tanned. The time taken may vary from 12 to 24 hours, depending on the particular class of hide that is being dealt with. When fully tanned a section of the hide shows a uniform bluish green colour throughout.

In the two-bath process the agent generally used is bichromate of soda, into an acid solution of which the hides are first put. Bichrome, however, does not in itself possess tanning properties, and the actual tanning takes place in the second bath, where the hides from the first bath are treated with an acid solution of hyposulphite of soda. The two-bath process is not nearly so popular as the one-bath, because of the great care which is necessary to prevent damage to the hides by the acid which is of necessity present in the baths.

Chrome tanning is now sometimes combined with vegetable tanning, so as to give a leather which has the properties of both kinds of leather. The great success of chrome leather is due not only to the short time occupied in tanning, but also to its strength and great resistance to moisture.

Messrs. White's Chrometan is equally suitable for the tannage of chrome upper leather, etc., and for the slower tannage of sole leather. They issue a brochure with full working details of the processes.

British Alizarine Co.

Chrome Tanning of Leather

The British Alizarine Co., Ltd., of Trafford Park, Manchester, are manufacturing a number of products for use in the chrome tanning of leather, and as these materials are obtained by them as by-products in their main manufacture, they are specially well placed for supplying the same at advantageous prices.

The chrome tanning process had its origin in the United States, and, inasmuch as the great advantage of this process is the obtaining of a serviceable leather in considerably less time than it can be produced by the older methods of tanning, it appeals strongly to the American inborn desire for speed. It can confidently be stated that chrome tannage may be completed in as many hours as the former process required days.

Before the war the process was adopted to a very large extent in Germany, with the result that in 1913 80 per cent. of the hides produced in India, estimated at 12,000,000 per annum, were tanned by the Central Powers, and mostly made into chrome leather, a very large proportion of this chrome leather finding its way back to the London market. Since the war considerable progress has been made with the process in this country, and the products supplied by the British Alizarine Co. have done much to foster this result.

The commodities prepared by the company comprise chrome tanning liquors of various grades, strengths, and degrees of basicity, to meet the varying requirements of the tanning industry, as well as basic chrome sulphate crystals and chrome alum. The method of carrying out the tannage is extremely simple: the goods are placed, preferably in a drum, in sufficient water to make a comfortable float, the pelts having been previously weighed, and the liquor is added in small quantities at a time. The total quantity of liquor necessary, in terms of chrome oxide, is between 2 and 2¾ per cent. on the weight of goods processed, and this should be added in not less than four portions as the tannage proceeds. The usual length of time required for complete tannage is about six hours, but in the case of thick goods it is sometimes advisable to keep them in the solution for a longer period. The material is satisfactorily processed when it is found, on making a test, that the resulting leather will withstand immersion in boiling water without being detrimentally affected.

In the case of basic chrome sulphate crystals, which are specially prepared for export purposes on account of their greater ease of transport, the required proportions should be dissolved in warm water and added to the skins as above stated.

Some tanners still prefer to employ chrome alum rather than the specially prepared products for tanning purposes, and in that case it is necessary to add a certain proportion of alkaline carbonate to the solution of chrome alum in order to bring about the degree of basicity necessary so as to secure a successful tannage.

F. W. Berk and Co., Ltd.

Lactic Acid in the Tanning Industry

The two main applications of lactic acid in tanning are in deliming and plumping, and although these two operations are carried out in very similar ways the methods of application differ in several essential details.

Deliming with lactic acid may be carried out either in pits or paddles, and the temperature should be maintained at about 85 deg. F. It is, of course, essential that there shall be sufficient lactic acid present to combine with the lime in the skins. If this condition is observed all the lime present is converted into calcium lactate, which is easily soluble in water, and herein lies the advantage of lactic acid.

Plumping with lactic acid should be carried out at low temperatures, 55 deg. to 60 deg. F. being most favourable. The time required varies according to the thickness of the pelt, and it is essential that there shall be free lactic acid present.

Lactic acid is also used for clearing leather before dyeing and glazing, where, in addition to its effect on the glaze, it is particularly efficient in the removal of iron stains and the stains which arise from the use of hard water.

It is essential that the lactic acid used in the leather trade shall be entirely free from iron and mineral acids, and the tanner should see that all his lactic acid is bought under a guarantee to this effect.

Curacit and Leather

Very few people realise the tremendous importance of surface tension and the part it plays in the treatment of leather. The surface tension film comes into operation wherever water is used, and everywhere it impedes the action of the chemicals dissolved in the water, impedes penetration, and is responsible for many of the uneven effects so frequently obtained in dyed leather.

If the surface tension film could be completely destroyed, tanning and dyeing leather would be a much simpler operation. But as this is not possible the only alternative is to reduce the strength of this film as far as ever possible.

With this object in view F. W. Berk and Co., Ltd., have placed on the market their preparation CURACIT, which, even in the very dilutest solution, produces a substantial decrease of the surface tension, as the result of which the last traces of grease are emulsified, dark coloured stains and unevennesses are removed, and the leather assumes a brighter and clearer colour. Also as a result of this, dyed leather is produced with brighter shades, and a better penetration is obtained.

Curacit has also a marked beneficial effect on the light resisting properties of coloured leather. This is the result of the efficiency of Curacit in removing foreign matter from the skins, a property which makes Curacit of value in practically all branches of the leather industry.

Kestner Evaporator and Engineering Co.

Wood Extract Manufacture

The Kestner Evaporator and Engineering Co., Ltd., have made a special study of tan extract plant, and their evaporators are used in practically every country in the world where this product is manufactured on a commercial scale. Kestners were the originators of the Film System and have been the pioneers of this form of evaporator. The Patent Film Evaporator offers a number of advantages which have only to be understood to be appreciated. The film principle ensures the maximum heat transfer efficiency and entirely avoids the over-heating and prolonged boiling which are so damaging to the quality of the extract. At the same time continuous operation reduces handling costs and ensures uniform conditions. A special feature of the plant is the separator which effectively prevents entrainment losses. Each form of calandria has the corresponding separator, either of the centrifugal or tangential type, and in each case the design is such that the more liable to frothing the liquor may be the less the possibility of entrainment. The designs are so effective that no loss by entrainment ever occurs.

The type of plant most usually installed is a Triple Effect Evaporator working under vacuum and fitted with multiple effect heaters, by means of which the advantages of working in triple effect are realised to the full. When solid extract is required, the triple is followed by a Kestner Patent Finisher Evaporator from which a finished product containing as little as 15 to 20 per cent. moisture is obtained depending on the extract. This machine has been specially developed for solid extract, and works on the continuous film principle under atmospheric pressure. The absence of condensing plant simplifies the installation and reduces upkeep costs, whilst the comparatively high temperature of the liquid enables exceptionally viscous liquors to be handled without difficulty and without any ill-effects on the extract; in fact the quality of the finished product is better than is the case with vacuum pans of the old type, which have the added complication of mechanical stirring gear. These plants are installed the world over for all kinds of extract, one firm alone having put down seventeen units of this type.

As pioneers in anything to do with extract plant Kestners have recently developed a system of drying the concentrated liquor so as to produce a finished extract in powder form in one operation. Briefly, the liquor passes through a high velocity spray working in an air heated chamber and is dried instantaneously. This system will have the great advantage of giving a very soluble form of extract. The Kestner Co. also specialises in leaching plant and manufactures extraction batteries of the closed, open, and continuously operated type, depending on the nature of the raw material. The autoclaves work under pressure on the counter-current principle and are designed to give extremely rapid charging and discharging.

With the open vat system the heating of the liquor is effected externally in a Kestner calorifier through which the liquor is circulated on the well-known system. The complete installations made by this firm include all their latest methods of clarifying and dealing with the liquors and their extensive experience ensures the use of thoroughly up-to-date plant. Particulars of the above and other plant may be obtained on application to 5, Grosvenor Gardens, London, S.W.1.

B. Laporte, Ltd.

The extensive works of B. Laporte, Ltd., occupying an ideal site of over thirty acres on the outskirts of Luton and adjoining the London and North-Eastern Railway, possess a thoroughly modern equipment. A considerable proportion of the plant is devoted to the manufacture of chemical products employed in the tanning and allied industries. These articles, bearing the "Laporte Brand," include sodium sulphide crystals 30/32 per cent., sodium sulphide concentrated solid 60/62 per cent., and sodium sulphide concentrated broken 60/62 per cent. These are produced by a special process, which furnishes a sulphide of very high quality, greatly favoured by consumers. In addition to its use as a depilatory in tanning, it is specially suitable for and extensively employed in dyeing and the production of sulphur dyes.

Sodium sulphite powder 60/62 per cent. SO_2, and sodium sulphite liquid 24/25 per cent. SO_2 are used by tanners for the reduction of bichromates. Hydrogen peroxide is produced of all strengths from 10 up to 120 volumes. This is a department of industry which has won for the firm and British chemistry world-wide notice, and so far as the tanning industry and allied industries are concerned it is used for the bleaching of parchment and for the production of a pure white on sheep skins, goat skins, etc. It is also largely used as an oxidising and developing agent in dyeing.

Lactic Acid in the Tanning Industry

The quality and final yield of heavy leather depends to a great extent on the condition of the first liquors. The early liquors seldom contain sufficient acid, especially in cold weather. They should contain enough free acid finally to remove the lime and to begin the acid swelling of the hide fibres. Succeeding liquors should show an increase in acidity. If there is insufficient acid (other than tannic) the tannic acid will contract and harden the fibres, but with sufficient lactic present this harmful action is counteracted. Lactic acid is also very effective as a substitute for bran drenching.

The chief cause of the rotting and decay of light leathers have been attributed by authorities to the presence of sulphuric acid. For this reason the replacement of sulphuric acid by lactic acid is suggested. No amount of washing will remove vitriol from the skins while lactic acid, being a vegetable acid, does not require washing out of the skins, and its presence

actually improves the substance. In the bleaching of leathers for curriers' purposes the substitution of two pints of lactic acid for every pint of sulphuric acid used under the old conditions will give a stronger and plumper leather without tendering the grain. In many processes lactic acid is an improvement over sulphuric, and in the manufacture of coloured chrome leathers a bath of lactic acid after mordanting is effective and saves intermediate washing.

Mr. Gerald McDonald, of 9, Botolph Lane, Eastcheap, E.C.3, has been interested in the commercial application of lactic acid from the first stages. In a booklet describing the first brand of lactic acid put on the market at a commercial price and guaranteed technically free from iron, he outlines its advantages. The particular product is stated to be free from all mineral and volatile acids, especially butyric. It is guaranteed against putrefaction and butyric formation, which results in weak grains and stains. It saves much time and labour in many processes, and its use promotes cleanliness. It is also odourless in used solution, and is safe for the workmen. The great point in its favour is that it does not harm the finished product.

Compagnie Commerciale Du Nord

The Compagnie Commerciale du Nord (London) offer a considerable range of various chemicals of interest to tanners. In most cases they are either agents for works or have a special working arrangement with the factories producing the goods, and thus are able to offer competitive prices. The goods are manufactured by up-to-date works, and the company claim that full confidence can be placed in the qualities offered. The various chemicals put on the market by them include acid oxalic, which tests fully 99/100 per cent., and is in the form of white crystals ; alum and chrome alum, of a high standard of purity ; barium chloride, supplied in two grades, namely, small and large crystals, of white colour, testing 98/100 per cent. ; Epsom salts and glauber salts ; sodium sulphite and bisulphite, supplied regularly to export tanners from their Belgian works ; sodium hyposulphite, usually testing fully 98 per cent. ; sodium sulphide, the solid concentrated testing 60/65 per cent., concentrated broken 60/65 per cent., and crystals 30/32 per cent., all guaranteed fully up to strength, and with facilities for regular contracts. Regular stocks are held in London and Antwerp of refined sulphur, namely, flowers of sulphur, ventilated sulphur, etc., and consequently prompt delivery can be given of small or large quantities.

New Mond Metal and Wood Preservatives

Following the details given last week of the new Mond product "Melanoid," it is now stated that the formula was first tested several years ago in an attempt to find a preservative that would stop the heavy loss occasioned by the corrosive action of the fumes from the works plant or the metal and wood fittings. The results obtained were surprisingly satisfactory. A number of bitumens were used in a finely ground state with a spirit base, and the colloidity of the paint produced appeared to surpass any bituminous preservative already on the market. Metal rods painted with it were found intact after long immersion in a 2 per cent. solution of sulphuric acid which had quickly softened and blistered oil paint and penetrated the metal beneath. One variety was turned out to dry in ten minutes.

Two brands are being put on the market in a number of forms. Melanoid is intended as a metal preservative ; Zulite is for wood. The current prices are competitive with other bituminous paints of good quality and the approximate bitumen content of the finished film is obtainable for each grade. As all the Melanoid grades are declared to contain at least 40 per cent. bitumen, the colour range is necessarily limited. Blacks are the staple product, but browns, light and dark reds, and greens are also to be had. Zulite, the wood preservative, offers wider colour possibilities. Nineteen shades are offered to harmonise with any colour scheme. It is claimed for Zulite that it penetrates farther than ordinary creosote, does not clog the cells of the timber, and is proof against the ravages of time, damp, dry-rot, fungi, insects, and vermin. It seems very ably to combine the needs of decoration with preservative utility. With the exception of a variety of Melanoid prepared specially for use in heavy industrial work, these paints are sufficiently thin and quick-drying to be applied by dipping or by spray.

Chemical Industry Conferences

To the Editor of The Chemical Age.

Sir,—For some weeks it has been my intention to write to you upon a subject that in my opinion is worthy of discussion—and shall I say acceptance in principle, if not in detail?—by those interested.

During the time that I have been engaged in the heavy chemical industry it has repeatedly occurred to me that it would be of great advantage, both economical and scientific, if the leaders of the industry could meet occasionally and discuss matters of importance, and especially those of technical advantage. For instance, take the National Sulphuric Acid Makers Association, which comprises the majority of the acid manufacturers of this country. Those in charge of their works must from time to time come up against technical difficulties which seem to be insurmountable, and yet, perhaps by a consultation, say once a month, these technical problems could be discussed without disclosing any business propositions. With the ever changing processes for the manufacture of sulphuric acid and the technical difficulties arising therefrom, it appears strongly to me that an area conference along the lines suggested would prove of great advantage to all concerned.

Could you insert this in The Chemical Age, and test the opinions of your readers?—Yours, etc., Geo. A. Smy.

119, Harcourt Road, West Ham, E.

The Manufacture of Salvarsan

To the Editor of The Chemical Age.

Sir,—Our attention has been directed to the article in your issue of June 13, 1925, page 576, by Dr. W. W. Myddleton, and to the association of our name with that of other firms who are issuing Salvarsan in this country.

There are two points in the second paragraph of the article which may cause misapprehension, namely, the date of manufacture in England and the demand for the product from America.

We were the first firm to apply to the Board of Trade for a licence to manufacture Salvarsan in this country, namely in September, 1914, and the first commercial batch was approved as early as December 21, 1914, after which date our output was constantly increased.

The applications for licences from other firms were in all cases later than ours—Messrs. Evans, Sons, Lescher and Webb's application, for instance, was not made until June, 1916. For some time the Salvarsan marketed by Messrs. May and Baker, Ltd., was manufactured in France.

British manufacturers could not supply American demands as the U.S.A. Federal Trade Commission ruled that licences granted under German-owned American patents would be restricted to products manufactured in the United States of America.—Yours, etc.,

Burroughs Wellcome and Co.

Snow Hill Buildings, E.C.1.

June 23.

Adhesives Research

The Department of Scientific and Industrial Research is carrying out a series of investigations into adhesives. Some of this work has direct industrial application ; some of it is of the nature of purely scientific research—*e.g.*, investigations into the chemistry of gelatin and the mechanism of adhesion. It is hoped that the more strictly scientific investigations will enlarge the present range of industrial application.

It has now been suggested by a prominent firm in the industry that they should be brought into closer contact with the fundamental scientific work, and they are prepared to contribute towards its cost. The Department has accepted this suggestion, and is accordingly prepared to make similar arrangements with other interested firms for this part of the work, and to furnish progress reports from the Committee in charge regularly to subscribers on the understanding that they will on their part communicate any information of general interest they may obtain from their own investigations, based upon the results of the Committee's researches. Further particulars as to the arrangements contemplated can be obtained on application to the Secretary, Department of Scientific and Industrial Research, 16, Old Queen Street, Westminster, S.W.1.

Synthetic Methyl Alcohol Production

German and French Developments

In view of the keen interest taken in the subject of synthetic methyl alcohol, the following review by R. T. Elworthy, Mines Branch, Canada, in "Canadian Chemistry and Metallurgy," gives a useful summary of recent developments in Germany and France respecting what is known in the United States and Canada as "Methanol."

THE production of methanol from water gas by the Badische Anilin und Soda Fabrik on a commercial scale in Germany has been known to those interested in the hard wood distillation industry for some time, but it has only received extended notice in the technical and scientific press of Great Britain and America in the last few months. This development, perhaps only second in importance to the Haber synthetic ammonia process, to which it is analogous, is of great significance.

The Badische Anilin und Soda Fabrik have had chemists and engineers working on this problem for a number of years, with the result that a large-scale commercial plant has been established at Merseberg in Saxony, which is producing several tons of synthetic methanol a day. The process, which is covered by a series of patents taken out in Germany, France, Great Britain, and the United States, consists in its essentials in the passage of purified water gas having the composition of approximately 60 per cent. hydrogen and 30 per cent. carbon monoxide, together with carbon dioxide and nitrogen, at a pressure of 200 atmospheres over a catalyst maintained at a temperature of about 400° C. The apparatus is of a similar type to that used in the Haber process.

The catalysts employed are mixtures of oxides of metals, belonging to different groups of the periodic table and not reducible by hydrogen or by carbon monoxide up to temperatures of 550° C. Examples given in the patent specifications are 90 parts zinc oxide mixed with ten parts chromic oxide, 85 parts zinc oxide and 15 parts vanadium oxide or 90 parts cadmium oxide and 10 parts chromic oxide.

The reaction in which a considerable percentage of the initial gases are combined, results in the formation of a mixture of watery and oily liquids from which pure methanol is separated by fractional distillation. Other aliphatic compounds of industrial importance are also separated. The development of a cheap motor spirit is an important possibility.

The products of the reaction between carbon monoxide and hydrogen under these conditions of temperature and pressure in the presence of catalysts have been exhaustively studied by Fischer.[1]

It has been found that the gases must be carefully purified, and freed particularly from sulphur and from volatile iron compounds. Activated carbon, soda lime, or hot caustic alkali convert the sulphur compounds to hydrogen sulphide, which is then removed. Iron compounds such as iron carbonyl are destroyed by passing over hot copper, copper mixed with a catalyst, or even over the catalyst such as is used in the process.

The Merseberg plant is producing 10 to 20 tons a day of methanol at a cost, it is believed, of about 20 cents per gallon.

It is only within the last few months that the output has been increased sufficiently to supply methanol for export, but already several hundreds of tons of this substance have been imported into the United States, and long-term contracts have been made by some of the principal users.

The French Process of M. Patart

A somewhat similar process has been developed by the French Government Laboratoire Central des Poudres under M. Patart, although it has not yet been tried out on a large manufacturing scale. This work has been described in some detail in *Chimie et Industrie*, Vol. 13, February, 1925, and in *Industrial and Engineering Chemistry*, Vol. 17, April, 1925. The French process, which is largely based on the valuable work of Sabatier and Senderens[2] and Sabatier and Mailhe[3] on the decomposition of methanol, uses a catalyst consisting of 90 per cent. copper and 10 per cent. zinc oxide. The best results are obtained at temperatures between 400° and 420° C. and at pressures of 150 to 250 atmospheres. About eighty per cent. of the liquid which is condensed out of the gases as they leave the reaction chamber, consists of methanol. The costs quoted work out to about 22 to 32 cents per gallon.

Researches of a similar character have been carried out under the auspices of M. Etienne Audibert, Directeur de la Société Nationale de Recherches sur le Traitement des Combustibles with the object of producing liquid hydrocarbons to serve as a motor spirit. In this work, catalysts composed of the sub-oxides of vanadium, molybdenum, tungsten, uranium, lead, and bismuth, have been experimented with, and much valuable information has been obtained thereby.

These developments are of great importance to Great Britain, which uses thousands of tons of methanol annually, most of it imported from the United States and Canada and costing £50 to £60 a ton. The German product can be laid down in London for £12 to £15 a ton. The production of crude and refined methanol in the United States in 1923 together amounted to between thirteen and fourteen million gallons, while the Canadian figure was somewhat more than 400,000 gallons. The average selling price in New York for the last year has been about 70 c. per gallon. The synthetic product can be sold for half that price. The present duty is 12 c. per gallon in the United States and $3 per gallon in Canada.

Undoubtedly plants utilising either the German or French patents will be soon established for the production of synthetic methanol in the United States.

The question of the supply and price of formaldehyde is involved in this development. At present the only method of manufacture of formaldehyde is by the partial oxidation of methanol, a process which has been brought to a high state of efficiency.

Formaldehyde is a chemical of increasing importance, its main uses being in the synthetic resin industry and as a disinfectant and fungicide. Cheaper methanol will mean cheaper formaldehyde and extended uses.

Canada was in the forefront of the development of the manufacture of acetic acid from acetylene. With the possible extension of coke oven plants in Ontario to provide a domestic fuel, large supplies of coke oven gas and water gas can be made available, and it is to be hoped that the development of industrial catalytic processes using such gases at high temperatures and pressures will receive the attention that the possibilities warrant; and that the reputation that was obtained by Canadian chemists and engineers at Shawinigan will be maintained.

[1] *Berichte* 56 *B*, pp. 2,428-43, 1923, *Chem. Abs.* 18, 459 and 3,705.
[2] *Ann. Chim. Phys.* (8) 4, p. 469, 1905.
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British Colour Users and Dyestuff Problems

Review of the Year's Work

In the annual report of the Colour Users' Association for the past year a review is made of the principal problems dealt with, including such matters as prices, statistical information, progress in dyemaking, and reparation supplies. The report is summarised below.

THE report, after stating the membership on April 30 to stand at 217, and expressing the Association's satisfaction at having had Mr. Sutcliffe Smith as chairman for the fourth year in succession, deals with the work of the various committees.

Licensing and Development

The Technical Advisory Committee has rendered great assistance in submitting recommendations and reports on matters referred to it, such as licences on price grounds, reparation treaty requisitions, disposal of reparation dyestuffs, strengths of pre-war and post-war German dyes, and quality of deliveries of reparation dyes. The Committee seeks to render assistance to members in any difficulties encountered in connection with supplies of colour, applications for licences, or other matters affecting their interests as colour users.

The Joint Technical Committee has continued to perform work of great value to the industry, in keeping up to date the list of non-contentious colours used by the Licensing Committee to facilitate granting of licences for such dyestuffs, and is now engaged on the preparation of a list of vat and anthracene dyes which are to remain at a factor of three times pre-war for a period of six months. The Council again records its appreciation of the services rendered by its representatives on the Dyestuffs Advisory Licensing Committee. Generally speaking, applications for licences have been dealt with very expeditiously during the year. The monthly reports issued by the Licensing Committee give an indication of the volume of applications dealt with, and the fact that they show such a high percentage dealt with within seven days of receipt is in no small degree due to the assiduity with which the Association's Technical Adviser (Mr. G. E. Holden) performs his duties. Assisted in many cases by his colleagues on the Technical Advisory Committee he has dealt with some 4,500 applications during the year. An arrangement has been in force for some time whereby applicants for licence to import Swiss dyestuffs, for which there were equivalent German products in reparation stock, were allowed to import the Swiss products if they had a preference for them. Owing to the urgent necessity for clearing the stocks of reparation dyes this arrangement has now been modified, applicants being allowed a licence for half the quantity they require provided they undertake to purchase a similar quantity of the German equivalent from reparation stocks.

The Dyestuffs Industry Development Committee meets at long intervals, and the Association's representatives are not entirely satisfied that it is tackling the problem before it—that of advising the Board of Trade as to the efficient and economical development of the dyemaking industry—in a manner likely to achieve good results. Some progress has, however, been made arising out of the compilation of the list of British made colours and their foreign equivalents, published early in 1924. A sub-committee of dye manufacturers has been set up to consider means to avoid overlapping in the manufacture of many dyestuffs and intermediates with a view to more economical production and lower prices.

Statistics Relating to Dyestuffs

For some considerable time it has been felt that the available statistics relating to the production, import, and export of dyestuffs, are too meagre to be of any real assistance in gauging the progress or otherwise of the industry. The Council has recommended to the Board of Trade the compilation and publication of details somewhat on the lines of those issued in America. A sub-committee has drawn up a complete scheme, upon which it is negotiating with the Statistical Department of the Board of Trade. Broadly, it is suggested that in the usual monthly trade and navigation returns the imports of dyes and dyestuffs, etc., should be shown according to the main sources of supply, and should be grouped in greater detail than is at present the case; also that exports and re-exports should be classified in a similar manner. It is also suggested that in addition to the monthly returns a detailed analysis of individual colours should be published quarterly. Similar data should also be published quarterly showing the production of the United Kingdom.

Two-and-a-Half Times Factor

The Chairman dealt with the question of the prices of dyewares at the annual general meeting, and emphasised the enormous cost borne by the users through the incidence of the Dyestuffs Act. He gave some convincing figures showing considerable decreases in the prices of the raw materials used in dyemaking since the three times factor had been accepted. After very careful consideration the Council asked the Licensing Committee to revise the principle which they have adopted in the consideration of applications for licences to import foreign dyestuffs on account of the foreign price being lower than the British, and suggested that where the British price is more than 2½ times the pre-war level as a maximum, and the foreign price is less, such difference should be accepted as a *prima facie* reason for the granting of a licence. The Manufacturers' representatives put forward certain counter proposals, but negotiations resulted in a satisfactory settlement, the factor of three being reduced to 2½ with the following provisos:—

(*a*) That the prices of all colours not previously made in Great Britain shall be stabilised for a period of six months from the date of the approval by the Licensing Committee of an authentic bulk sample of such new product at a price equivalent to that which in the opinion of the Informal Price Committee was ruling for the corresponding foreign colour at a date three months prior to the deposit of the sample of the new British colour with the committee.

(*b*) That in the case of such vat and anthracene colours as may be specified in a list to be drawn up on the advice of the Joint Technical Committee the factor shall remain at three for a period of six months and then be reduced to 2½ unless otherwise agreed.

Price of Indigo

A matter which has been exercising the activities of the Council is the price charged by the British makers for indigo 20 per cent. paste, as compared with the price at which it is offered by manufacturers in Germany, Switzerland, and America. Foreign competitors of British indigo dyers and printers can, of course, obtain supplies of the cheaper foreign product, and as indigo figures largely in the production-cost particularly of indigo printed goods, it is maintained that the incidence of the price is so serious as to be mainly responsible for the shrinkage in the output of indigo prints, which is estimated in some quarters to be quite 60 per cent. The position is very acute, and the Council is thoroughly investigating the whole question with a view to taking strong action to bring about relief to users. Strong representations have been made to the British makers and the Dyestuffs Licensing Committee, and both these bodies have been made fully cognisant of the attitude of users and their needs in this respect.

Reparation Dyestuffs

At the commencement of the year, the question of the continuance of supplies of reparation dyestuffs after December 31, 1924, when they lapsed under the terms of the Versailles Treaty, required careful consideration from many points of view. The chief of these was, that, although the Germans did not appear to be anxious to continue to supply dyestuffs as reparation, France, Italy, and Belgium were pressing strongly for a prolongation of the period referred to in the Treaty. Probably the majority of colour users in this country were against their continuing, and the attitude of the Government appeared to be neutral. The Council came to the conclusion that if the Allies intended to continue it might be detrimental to the interests of British users if they did not continue also. It was, however, strongly represented that the requisitioning must be on a more businesslike footing, and with this end in view a sub-committee consulted with

Dr. Hay, the British Delegate on the Reparation Commission for Dyestuffs, and with his advice and assistance a complete scheme was drawn up for the working of the dyestuffs section of the London Agreement on a sound businesslike basis. The sub-committee also obtained a great deal of valuable information as to the methods adopted by the French, Belgians, and Italians, to which due regard was paid in drafting the proposed British scheme.

The Council had several conferences with representatives of the Government, and later Mr. Percy Ashley (Secretary of the Industries and Manufactures Department of the Board of Trade) intimated that, as the Government could get all the payments of reparation to which they were entitled from sources other than dyestuffs, they did not wish to press users to take dyes as reparation. In all the circumstances, it was felt that no useful purpose would be served by taking dyes as reparation, but it was pointed out that there should be some safeguard in case it was found that the Allies were obtaining any benefits that might be barred to British users. The sub-Committee again consulted with representatives of the Government, with Dr. Hay, and finally with representatives of the I.G., the outcome of which was an agreement between the Government and the I.G., whereby the Government can commence to take dyes as reparation on giving one month's notice to the I.G.

The position at present is briefly :—(1) Reparation deliveries have ceased, but (2) they may be recommenced on one month's notice. (3) Reparations cease definitely in August, 1928, unless a further extension is agreed upon.

The accounts for the year show an excess of receipts over payments of £392 and a balance of cash at bank amounting to £3,965 6s. 1d.

An Unsuccessful Oil Venture

A MEETING of the creditors of The New Motor Spirit Co., Ltd., Colnbrook, Slough, Bucks, was held on June 23 in London. Mr. Patterson, who occupied the chair, said that he might as well tell the creditors at once that the company had no assets whatsoever. The total liabilities were £63,098 2s. 9d. A secret process involved was for the production of proof spirit from crude oil, and in his opinion that process was valueless.

Mr. Patterson read a report presented at the last meeting of the company. After the company had produced a certain quantity of spirit at the works, the directors called in, for expert advice, the late Professor Harker, one of the leading oil experts in this country, and the only Government representative on the Petroleum Commission. The company also called in Mr. Robert Redwood. They also, on the advice of Sir Gould Adams, who agreed to act in an advisory capacity to the company, engaged the service of Captain Nobbs, an eminent oil chemist. Professor Harker agreed to join the company as technical adviser, and on the advice of that gentleman, the works at Colnbrook were stopped three months so that "safety first" measures under his advice could be adopted. During this period the inventor Heath, who was the discoverer of the light spirit from hydrocarbon, purchased electrical machinery costing a large amount, which he stated was necessary for the mass treatment of gas oil, and he claimed to treat it on a more productive scale than hydrocarbon. At that time there was a growing scarcity of hydrocarbon, as the railway companies, who hitherto had been selling this, were actually reserving it and using it themselves. So much so, that it was found that no more than 30,000 gallons were available annually. At one of the meetings at the works, with the experts in attendance, Heath actually did produce from hydrocarbon a light spirit which hitherto was unknown to science. The spirit produced at the works had a specific gravity of 560 degrees. When all measures of safety had been attended to, Heath was to give a demonstration of producing 50 per cent. of fine spirit from gas oil. The result appeared eminently satisfactory, but later proved otherwise. Although the company possessed the secret of making a fine spirit hitherto unknown to science that could only be obtained from the hydrocarbon of shale oil, the quantities were totally inadequate for the financial success of the company. The directors tried to make arrangements with shale oil companies, but without success.

No resolutions were passed and the matter, therefore, remained in the hands of Mr. W. H. Cork as liquidator.

The National Physical Laboratory

Inspection by the General Board

THE annual visit of the General Board to the National Physical Laboratory, Teddington, took place on Tuesday, and an interesting additional feature to the usual programme was the ceremonial opening of the new entrance gates to the Laboratory grounds. An imposing pair of iron gates open on to Queen's Road and these were draped for the occasion with Union Jacks. Speeches were made by Sir Charles Sherrington, President of the Royal Society, and Lord Rayleigh, after which the gates were opened by a special key, which bore the monogram of the Laboratory and was handed over by Sir Lionel Earle, Secretary to H.M. Office of Works. The guests were afterwards received in the new Aerodynamics building by Sir Charles Sherrington, Sir Arthur Shuster, and Sir Joseph Petavel.

Over a thousand people had accepted invitations to be present and, in contrast to the colder spell of the previous days, the weather was perfect for the occasion. The buildings of the Laboratory are arranged among flower-bedded lawns and trees, and a better day could not have been desired. Among the members of the General Board attending were Sir William Bragg, Professor Coker, Sir R. Glazebrook, Sir Robert Hadfield, Professor Merton, and Sir Alfred Yarrow.

The experiments and apparatus shown in the several departments were so many and varied that space will permit the description of only a few of them, but several of the exhibits were unusually impressive. To stand in a vast wind-tunnel in the Aerodynamics building, for instance, and to see a large scale Bristol Fighter model respond to a current of air from a huge electric fan is an experience not easily forgotten. Next was seen the William Froude Tank, which is over 150 yards long and has a depth of 11 feet of water to enable investigation of the movements of models of ships to be made with the minimum of experimental error. Experiments are made from a gigantic platform which travels above the tank, and it is found in this way that Nelson's flagship, the *Victory*, was about 45 per cent. less efficient than present-day ships.

Mangling Metals

In the Metallurgical department was seen perhaps the finest equipment for the experimental study of metals to be found anywhere in the world. Among the most interesting exhibits was a full-size rolling mill, very like a large mangle, and fed from a furnace nearby with slabs of aluminium. A thick piece is previously heated to about 450° and then compressed many times in succession between the rollers, the process resulting in a larger and thinner sheet of metal. Microscopic photographs of the complex structure of alloys were on view, some of which showed the behaviour of metals under strain and the allied phenomenon of "fatigue." Much attention is being given at present to metals having high melting points and to the refractory materials required to hold them in furnaces and crucibles, and in this connection an exhibit of China Clay was on view, together with samples of iron and manganese in a state of purity not hitherto attained.

The National Chemical Laboratory

Teddington has an additional interest at the moment, as the new National Chemical Research Laboratory is being built there. This will be under the direction of Professor G. T. Morgan, late of Birmingham University, and it is hoped that the building will be opened in September, although this has not been announced officially as yet. It is situated close by the grounds of the Physical Laboratory and is liable to be mistaken for one of its departments, as the whole building is a great deal smaller than many of those of its older neighbour. The work will probably be finished by the end of August, although labour troubles have considerably hindered its progress, but half of the roof is already complete and the finishing of the inside walls has begun.

The success of a most enjoyable afternoon's visit to the National Physical Laboratory was not due to the interesting exhibits alone but to the admirable organisation of the whole exhibition. Everywhere most lucid notices directed the visitors, and not the least important of these was a placard announcing a delightful tea which was provided for the guests.

Anglo-American Friendship

A VERY pleasant example of the friendly relations between chemical interests in this country and the United States was furnished by a little party at the Chemical Industry Club, London, last week, when Mr. M. C. Whitaker (vice-president of the U.S. Industrial Alcohol Co., New York, and President of the U.S.A. Synthetic Organic Chemical Manufacturers' Association) entertained to lunch a few English friends associated with chemical publications. These included Dr. Stephen Miall (*Chemistry and Industry*), Dr. Longstaff (secretary of the Society of Chemical Industry), Mr. T. F. Burton (*J.S.C.I.*), Mr. Hughes (*Chemical Trade Journal*), and Mr. F. E. Hamer (THE CHEMICAL AGE).

Mr. Whitaker, in addition to being a prominent figure in the industrial world, has found time to give considerable attention to the work of the American Chemical Society. Long ago he recognised that if chemistry and chemists were to get recognised at their full value from the public point of view it would be necessary to take steps to interpret their work through the general press to the general public. There were the usual professional and traditional prejudices to be overcome, but, thanks largely to Mr. Whitaker's tactful and persistent efforts, these have been worn down, and so beneficial have been the effects of the systematic publicity plan organised that the American Society's allocation to this work has steadily increased. Mr. Whitaker's account of this kind of propaganda, with the object of putting the chemist "on the map," was listened to with great interest and suggested sound lines for suitable work here.

One of the special objects that Mr. Whitaker (who has now returned to New York after a European tour of some weeks) had in view was to consult with M. Patart of Paris as to his synthetic methyl alcohol process, in which great interest is taken in the United States. It appears that M. Patart has only taken out French patents for his process, and several commercial interests in the United States and elsewhere are contemplating negotiations as to the American and other rights. No definite conclusion, we understand, has been reached, but the position is one to which this country cannot afford to be indifferent.

The cordial thanks of the guests were offered to Mr. Whitaker, who was asked to convey to all American friends the good wishes of their colleagues in this country.

An Empire Base Metal Industry

SPEAKING on Tuesday at the annual general meeting of the Zinc Corporation, Ltd., in London, Mr. F. A. Govett, chairman, referred to the possibilities of linking up the various groups that are engaged in converting British raw material into metal and in marketing the products throughout the world. He referred to the formation of the Zinc Producers' Association, followed by Electrolytic Zinc and other subsidiary companies in which the Corporation took their share. They must not stop until they controlled the base metal business of the Empire for the double purpose of making the Empire independent, and keeping in British hands profits that, before the war, went to the German ring. The Corporation held interests in the British Metal Corporation and the National Smelting concern.

Present prices were rather low—about £33—and the general feeling was that prices for the immediate future would range about £30 or a little higher, but profits for the current year should be about the same, although labour charges would be higher. He referred to the prosperity of the associated companies—Electrolytic Zinc, the Associated Smelters Co., and also the National Smelters. The Southern European Metal Corporation was developing very satisfactorily.

The difficulty of labour questions and the adoption of just schemes of profit sharing were important factors in their prosperity, but recent agreements with the mine workers made this field seem fairly hopeful for the future. A sliding scale scheme of profit sharing had been agreed.

Mr. Govett sounded a note of warning when he reminded them that the pre-war price of lead was about £17, but it was now about £33. While prospects were favourable it was well to remember that they were working on an abnormal figure. Details of the financial results are given in our Company News.

Chemical Matters in Parliament

Silk Duty Revenue

Mr. Guinness (House of Commons, June 19) said that the estimated yield in a full year of the Customs Duty on "raw silk," described as such in the trade accounts of the United Kingdom, was approximately £105,000.

Development of Industry

Sir Leslie Scott (House of Commons, June 22), speaking on the subject of the Finance Bill, moved a new clause which, he said, proposed that the rate of income tax to be charged upon that portion of a company's profits not distributed to the shareholders, but used for development, should be lower than the whole standard rate. The principle of the clause, he said, was to provide a financial stimulus to every board of directors to use as large a part of the profits as possible for the purpose of developing the company instead of distributing it among the shareholders. The result would be an improvement in trade, a diminution in unemployment, and a greater yield of taxes to the Exchequer. He urged that, if it was not possible from revenue reasons to adopt the clause this year its principle would be adopted next spring.

Sir A. Mond seconded.

Mr. W. Guinness said that the clause would involve a loss of revenue of £7,500,000 per year, while that in the name of Sir A. Mond would mean a loss of £13,000,000. The Chancellor of the Exchequer authorised him to say that he was going to explore the subject in all its bearings and see if there was any method by which it could be dealt with on a fair and satisfactory basis. He (Mr. Guinness) feared the proposed remission of taxation would be a subsidy, not to reserves, but to dividends. It would involve a revolutionary change in our system of taxation, and our premier tax would become a tax not on income, but on expenditure.

The amendment was negatived without a division.

Sugar Beet Factory Costs

Mr. Wood (House of Commons, June 22), in reply to Mr. Christie, said that the total estimated capital cost of the six factories now in course of erection was £1,826,000, of which £1,563,000, or over 85 per cent., was being expended in this country.

The following figures were given :—

	Estimated total capital cost.	Estimated outlay abroad.
	£	£
Ely	358,100	81,000
Ipswich	377,900	105,000
Bury St. Edmunds	300,000	30,000
Wissington	300,000	30,000
Spalding	245,000	8,200
Kidderminster	245,000	8,200
Total	£1,826,000	£262,400

Mr. Maxton asked how much of the subsidy required from the British Treasury was going into the pockets of foreign capitalists and was asked to put a question down on the subject.

Road Surfacing Research

Sir Harry Brittain (House of Commons, June 23) asked the Minister of Transport whether research was bringing forth any new material to render the surface of the new trunk roads less dangerous after rain.

Colonel Ashley said that he had every reason to hope that the process of surface dressing and gritting which was being applied to slippery road surfaces would effect the desired purpose. Should the Roads Improvement Bill become law, it was his intention to pursue further experiments. The slipperiness of the present trunk roads was being remedied.

Spirits for Methylation

Mr. Churchill (House of Commons, June 23), in reply to a question by Mr. D. Reid, said that the number of proof gallons of imported spirits used during the year ending March 31, 1925, for methylation was 597,128. Home made spirits used for this purpose totalled 7,600,146 proof gallons.

From Week to Week

THE ADDRESS of the British Cyanides Co., Ltd., as from June 24, is 49, Wellington Street, Strand, London, W.C.2.

THE ADDRESS of W. A. Burton (" Prodorite ") has been changed to Aldwych House, Aldwych, London, W.C.2. The telephone No. is Holborn 5185.

COURTAULDS, LTD., have erected a factory at Cornwall, Ontario, and the manufacture of artificial silk from Canadian sulphite pulp will be started shortly.

MR. E. BROTHERTON-RATCLIFFE, managing director of Brotherton-Ratcliffe and Co., Ltd., London, has returned from a six weeks' business tour in the United States.

DISEASES OF OCCUPATION recorded in May included 26 cases of lead poisoning, 16 cases of epitheliomatous ulceration (including 9 in the oil and 5 in the pitch industries), and 4 cases of chrome ulceration.

THE BURSTING OF AN ACID DRUM at the works of the Cassel Cyanide Gold Extracting Co., Maryhill, resulted in the death of a foreman who was supervising the handling of the drum when it exploded without warning.

KELVIN, BOTTOMLEY AND BAIRD, LTD., of 51/52, Fenchurch Street, London, E.C.3, notify us that they have taken over the Fade-Ometer, Daylighting equipment, Solar-lite and Printing arc lamp business of A. D. Lang, Ltd., 42, Berners Street, London, W.1.

RUNNING COSTS OF OIL FUEL are considered greater than coal costs, especially in Great Britain, according to Mr. C. B. Collett, chief mining engineer of the Great Western Railway, speaking at the International Railway Congress on Tuesday. A questionnaire revealed the fact that 21 of 35 British and Colonial railways used coal fuel, and 2 Colonial railways used oil fuel over sections of their lines.

A CONTRACT for supply of mineral lubricating oils, for the Egyptian State Railways, Telegraphs and Telephones, has been given to Silvertown Lubricants, Ltd., London, for 400 metrical tons engine oil " C," summer quality, at the price of £E.12.700 milliemes per metrical ton, and 300 metrical tons engine oil " C," winter quality, at the price of £E.12.320 milliemes per metrical ton, all delivered at Quay Gabbary, Alexandria.

THE FOLLOWING TENDER PRICES were recommended for acceptance at a recent meeting of the Camberwell Guardians: Drugs, Hodgkinson, Prestons and King, 263, Bishopsgate, E.C., they allowing 45 per cent. off their current price list; phenol at 18s. 8d. per 28 lb.; Duncan Flockhart and Co., 155, Farringdon Road, E.C., Salamons ether at 2s. 2½d. per lb., chloroform at 3s. per lb.; Preston, Corndale and Co., 34, Sumner Road, S.E., Lysol at 19s. 6d. per 5 gall. drum, liquid paraffin at 6s. 6d. per gall.; chemical food at 5¾d. per lb.; The Methylating Co., Hutton Road, Lambeth, methylated spirit at 2s. 9d. per gall.; J. Burroughs and Co., Hutton Road, Lambeth, rectified spirit, at £6 4s. 7d. per gall.

THE FARADAY SOCIETY will hold its annual general meeting in the rooms of the Chemical Society, Burlington House, Piccadilly, London, W., on Monday, July 6, at 5.15 p.m. At an ordinary meeting following at 5.30 p.m., the papers read will probably include:—" The Electrodeposition of Zinc from Acid Zinc Sulphate Solutions " (A. L. Marshall); " The Nature of the Interfacial Layer between an Aqueous and a Non-Aqueous Phase " (F. L. Usher); " The Application of the Quinhydrone Electrode to the Measurement of pH Values in Solutions containing Copper Ions and other Divalent Ions " (J. B. O'Sullivan); " Co-ordination and Valency " (J. A. V. Butler); " A Chemical Theory of Remanent Magnetism " (E. D. Campbell).

APPLICATIONS ARE INVITED for the following appointments:—A research worker on adhesives in the Department of Scientific and Industrial Research—Secretary, 16, Old Queen Street, S.W.1, by June 27; Junior assistant in the Metallurgical Department of the National Physical Laboratory—Director, N.P.L., Teddington, by July 4; Lecturer in physics and mathematics, at the Northampton Polytechnic Institute—Principal, St. John Street, London, E.C.1, by July 6; Lecturer in physics, Durham University—Head of the Department of Pure Science, South Road, Durham, by July 11; Junior assistant (physics) at the Shirley Intitute, British Cotton Industry Research Association—Director, Shirley Institute, Didsbury, Manchester, by July 15.

IN PURSUANCE OF THE POLICY of carrying out the physical and chemical survey of the national coal resources, with the help of local committees, the Fuel Research Board have appointed the following committee to deal with the physical and chemical survey of the coal seams in the North Staffordshire area:—North Staffordshire Colliery Owners' Association: Mr. J. Cocks, Mr. J. Gregory, Mr. G. P. Hyslop, and Mr. E. P. Turner. North Staffordshire Institute of Mining Engineers: Mr. S. Henshaw. The Geological Survey of Great Britain: Mr. J. A. Howe. The Fuel Research Board: Dr. C. H. Lander (*ex officio*), Director of Fuel Research, and Mr. F. S. Sinnatt (*ex officio*), Superintendent of the Physical and Chemical Survey of the National Coal Resources.

MR. K. J. MACKENZIE, director of research of the Texas Co., has been elected president of the Chemists' Club, New York.

CAMBRIDGE UNIVERSITY AWARDS include a Shuttleworth Studentship in Chemistry to Mr. R. V. Thomas (Gonville and Caius College).

FATAL ACCIDENTS IN THE CHEMICAL, ETC., INDUSTRY during May numbered seven, and two cases were recorded for the clay, stone, glass, etc., industry.

UNITED STATES TAR DYE IMPORTS during May declined considerably. The official reports show a total of 370,271 lb., as compared with 451,005 lb. in April. The imports are the smallest so far this year.

UNEMPLOYED INSURED WORKERS in the chemicals, etc., industry totalled 8,763 during May—7,449 men and 1,314 women. This represented an increase of 1 per cent. on the total compared with the previous month.

PROFESSOR ELIHU THOMSON, one of the founders of the General Electric Co. and a director of the company's research laboratory at Lynn, Mass., has been awarded the Franklin medal and honorary membership of the Institute.

" THE FULL CASUALTIES " from tetra ethyl gas at the manufactory at Deepwater, New Jersey, are stated by the *New York Times* to number 300. These persons are stated to have been affected by lead poisoning in 18 months and that 8 have died—four this year.

PROFESSOR FINDLAY, head of the Department of Chemistry at Aberdeen, is at present a visiting professor at Leland Stanford University, U.S.A. He recently addressed the Southern California Section of the American Chemical Society on " The Appeal of Science to the Community."

DAMAGES AMOUNTING TO £3,120 were on Wednesday awarded to Mr. W. L. Hargreaves, chief mechanical engineer to Lever Brothers, Ltd., Port Sunlight, against a Mold poultry farmer for injuries sustained in a collision between Mr. Hargreaves's bicycle and defendant's motor van. It was contended the plaintiff had developed cancer in consequence of his injuries.

" MORE CHEMISTS WANTED," was the keynote of a speech by Lord Colwyn at a school gathering at Colwyn Bay, on Saturday, June 20. He considered that there were not half enough chemists in this country. Germany employed ten times as many, and in this country chemistry ought to be an integral part of every industry. There was a difficulty in finding openings in this country, but South America seemed to offer scope for trained men.

MR. H. SUTCLIFFE SMITH, of the Bradford Dyers' Association, complained on Wednesday, at a meeting of the Council of the Bradford Chamber of Commerce, of the procedure adopted before the Balfour Committee on Industry and Trade in giving evidence on the state of the textile trade by representatives of the West Riding Chambers of Commerce. He said that it was not in accordance with precedence that certain sections of the Chamber should make charges against another section without that section having an opportunity of submitting its view of the position. He was understood to be referring to remarks made by Mr. D. Hamilton concerning charges made by the dyeing section of the trade.

THE DEPARTMENT OF OVERSEAS TRADE desires to remind United Kingdom exporters requiring information on overseas commercial matters that it is always desirable to approach the Department rather than to write directly to the Department's representative posted in the market concerned. The information desired is frequently already available in the Department, and direct application saves time. Where the information is not so available, the Department takes immediate steps to secure it and to forward it to the inquirer. It is particularly emphasised that the method adopted by some inquirers of addressing the same inquiry simultaneously to the Department and its overseas officers leads to unnecessary duplication of work and to delay.

Obituary

MR. GEORGE LINCOLN GOODEN, managing director of the Spinningfield Chemical Co., Ltd., of Manchester, in his 48th year.

MR. A. SEYMOUR JONES, an authority on anthrax and formerly connected in a scientific capacity with J. Meredith Jones and Sons, Ltd., Cambrian Leather Works.

MR. REGINALD SUGDEN, M.Sc., senior chemistry master at West Leeds High School and for several years works chemist to George Bray, Ltd., gas engineers, of Leeds, aged 33 years.

BARON COPPÉE, a Belgian multi-millionaire coal-owner, who in February last was ordered by the Brabant Assize Court to pay £215,000 damages to the State for supplying coal products to the Germans during the war. A superior court in April quashed the fine and ordered a rehearing of the case.

SENATOR LADD, of North Dakota, in his 66th year. He took his science degree at Maine University and became chief chemist of the New York State Experimental Station. He was afterwards Dean of the School of Chemistry and Pharmacy of the North Dakota Agricultural College, President of the College, and State Chemist.

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Patent Literature

Abstracts of Complete Specifications

234,161. Carbon or Carboniferous Products, Production of. S. G. S. Dicker, London. From G. W. Wallace, 1,340, Mission Street, San Francisco, Cal., U.S.A. Application date, January 25, 1924.

The object is to obtain active decolorising carbon. The heat necessary for the carbonisation is generated in front of the charge so that a zone of distillation precedes the zone of carbonisation, which in turn precedes the zone of combustion. The latter is produced by burning gas or liquid fuel, and/or part of the charge. The carbonisation thus takes place with material freed from volatile constituents, so that no free carbon can be deposited in the pores of the material. The product is then cooled by quenching within the retort, and the steam generated expels any gas from the retort, so that any reduction of activity of the carbon due to contact with air is avoided. The charge may then be conveyed to tanks to be treated with solvents for the activating agents employed. The carbonising heat is supplied at the top of the charge, and the zones of distillation, carbonisation, and combustion travel downwards.

234,163. Organic Peroxides or other Organic Per-Compounds, Process for rendering safer for Handling or Other Purposes. Naamlooze Vennootschap Industrieele Maatschappij, v.h. Noury and Van der Lande, and J. C. L. van der Lande, Deventer, Holland. Application date, February 12, 1924.

The object is to diminish the tendency of various percompounds to explode when handled or used, and the process may be applied to organic peroxides such as benzoyl peroxide, cinnamyl peroxide, and acetyl peroxide, and other organic percompounds, such as peracetic acid, perpropionic acid, persalts and organic peroxygenium compounds, including peraldehydes, ozonides, such as cyclohexane ozonide, oxozonides, such as butylene oxozonide, ozonide peroxides, such as allyl acetone ozonide peroxide, and oxozonide peroxides such as oleic acid oxozonide peroxide. It has been found that the tendency to explode under percussion is reduced when these substances are mixed with indifferent substances such as inorganic oxides, carbonates, sulphates, chlorides, phosphates, or silicates of magnesium, calcium, potassium, sodium, or ammonium, and organic salts such as acetates, lactates, citrates or tartrates, and also flour or flour products. The addition is chosen according to the purpose for which the percompound is to be employed.

234,173. Vat Dyestuffs of the Dibenzanthrone Series, Manufacture of. O. Y. Imray, London. From Farbwerke vorm. Meister, Lucius and Brüning, Hoechst-on-Main, Germany. Application date, February 20, 1924.

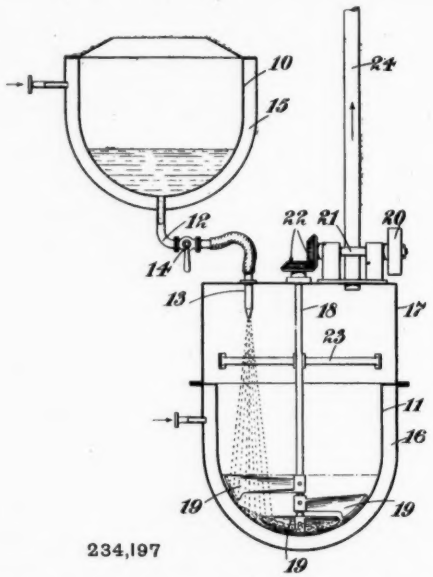
Oxydibenzanthrones can be obtained by fusion with alkali of such oxybenzanthrones as have in the peri-positions of the naphthalene nucleus no substituent or only halogen; when alkyl residues are introduced into the oxy groups of these oxydibenzanthrones, dyestuffs are obtained. In an example, the benzanthrone obtained from desoxyalizarine is added to fused caustic potash and maintained at 250° C. until a sample gives a violet-red solution in water. The corresponding hydroxylated dibenzanthrone is precipitated by acidifying the alkaline solution. The condensation product may be treated in nitrobenzene with paratoluene-sulphonic acid methyl ester and sodium carbonate, and the solid residue boiled with alcohol dissolved in concentrated sulphuric acid, and the dyestuff precipitated by adding water. Several other examples are given starting from various other oxybenzanthrones.

234,192. Hexamethylene-Tetramine, Manufacture of. H. Wade, London. From S. Karpen and Bros., 678, West 22nd Street, Chicago, Ill., U.S.A. Application date, February 26th, 1924.

The object is to obtain hexamethylene tetramine in a comparatively short time, and without the use of very high pressures. It has been found that the desired reaction takes place between methylene chloride and liquid ammonia at a raised temperature, using a large excess of ammonia. Thus, at a temperature of 60° C., and employing 100 per cent. excess of ammonia, the reaction is completed in about 114 hours, but with 300 per cent. excess of ammonia the time is reduced to 50 hours. It is preferred to employ a temperature of 60° C., at which the pressure is about 380 lb. per square inch. After completion of the reaction, the excess of ammonia is distilled off and the hexamethylene-tetramine is dissolved out from the residue by means of chloroform or carbon tetrachloride. The residue of ammonium chloride may be treated with lime to recover the ammonia for use again. The reaction may be completed within the same time by using only 200 per cent. excess of ammonia, if the temperature and pressure are raised further. The hexamethylene-tetramine obtained is of high purity.

234,197. Crystallisation and Drying of Soluble Substances. J. T. Millar, 24, Inverness Terrace, London, W.2. Application date, February 29, 1924.

The process is more particularly for use in the manufacture of pyro-phosphates of soda, and the object is to avoid the difficulties usually experienced due to the tendency of the phosphate to congeal. A hot concentrated solution of the



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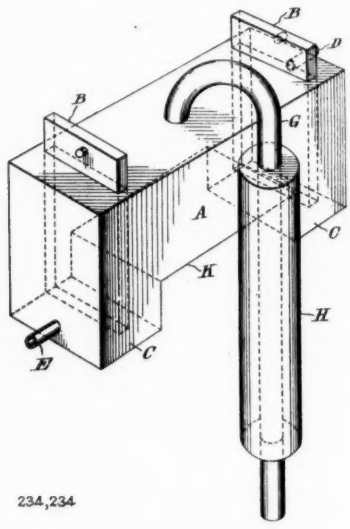
substance is injected in finely divided form into a heated space above a nucleus charge of the crystals of the substance. The solution is heated in a vessel 10 having a steam jacket 15, and is passed through a pipe 12 and nozzle 13 to the crystallising chamber 11. The lower part of the chamber 11 has a heating jacket 16, and is provided with a rotary agitator 19 mounted on a shaft 18, so that the crystals in the bottom of the vessel are subjected to a rolling form of agitation. A concentrated solution of sodium dihydrogen phosphate having a specific gravity of 1·65 to 1·75 is maintained in the vessel 10, and a nucleus charge of the crystallised phosphate is placed in the vessel 11. The temperature of the vessel 10 is raised to 170° C., and the solution injected into the vessel 11, where rapid evaporation takes place. The crystals deposited adhere to the nucleus crystals, and the agitation prevents their adhering to one another. When the supply of liquid to the nozzle 13 is cut off, heating of the crystals is continued for two to four hours. The crystallisation is facilitated by decreasing the pressure in the chamber 11.

234,234. Heating and Distilling Liquids, Process and Apparatus for. E. C. R. Marks, London. From the Grasselli Chemical Co., 1,300 Guardian Building, Cleveland, Ohio, U.S.A. Application date, March 31, 1924.

The process is for concentrating and distilling crude acid solutions, such as sulphuric, nitric or hydrochloric acid, by means of heat generated by passing an electric current through the liquid. The process is a continuous one, and is therefore simpler than the usual "batch" operation employed for

concentrating hydrochloric acid. A retort *A* has a deeper portion *C* at each end, and an intermediate shallow portion forming a bridge *K*. A graphite electrode *B* is placed in each well *C*, and pipes *D*, *E* are provided for supplying and discharging the crude acid and residual acid respectively. The condenser tube *G* passes through a cooling tube *H*, and thence to a receiver. The heating is effected by a low voltage alternating current, any voltage between 25 and 220 being satis-



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factory. The rate of heating is regulated by varying the voltage or the depth of acid over the bridge *K*. A distillate of maximum concentration is continuously produced. The residual acid containing impurities is continuously drawn off. Electrolysis of the liquid does not take place if the area of the plates *B* is large relatively to the cross-section of the liquid over the bridge *K*.

234,263. Dyestuff Intermediate, Manufacture of. British Alizarine Co., Ltd., J. Anderson, and W. H. Dawson, Westinghouse Road, Trafford Park, Manchester. Application date, May 6, 1924.

A dyestuff intermediate is obtained by reducing 1 : 4 : 5-dihydroxy-anthraquinone to the leuco compound by alkaline hydrosulphite.

234,319. Substantive Azo Dyestuffs, Manufacture of. Soc. of Chemical Industry in Basle, Switzerland, and H. Fritzsche, 64, Batterieweg, Basle, Switzerland. Application date, July 22, 1924. Addition to 219,653.

Specification No. 219,653 (See The Chemical Age, Vol. XI, p. 331) describes the production of azo dyestuffs by converting an amino-1-aryl-5-pyrazolone into its urea derivative by treating with phosgene in the presence of an acid-binding agent, and coupling this derivative with two molecular proportions of a diazo-azo-compound of the aromatic series or with one molecular proportion of two different diazo-azo compounds. Alternatively a diazo-azo compound of the aromatic series was coupled with one molecular proportion of an amino-1-aryl-5-pyrazolone, an acidyl-amino-1-aryl-5-pyrazolone, or a nitro-1-aryl-5-pyrazolone, and the diazo dyestuff thus produced converted into its urea derivative by treating with phosgene in the presence of an acid-binding agent. This invention consists in the substitution of an amino-disazo dyestuff wholly or partly for the amino-azo dyestuffs used as diazotised components in the manufacture. The resulting dyestuffs are of good fastness to light, and are readily discharged.

Note.—Abstracts of the following specifications which are now accepted, appeared in The Chemical Age when they became open to inspection under the International Convention :—211,886 (Ges. für Chemische Produktion) relating to manufacture of highly active adsorption carbon, see Vol. X, p. 471 ; 218,629 (Amber Size and Chemical Co., Ltd.) relating to production of aluminium compounds for paper-making and other purposes, see Vol. XI, p. 270.

International Specifications not yet Accepted

232,264. Perylene Compounds. H. Pereira, 3, Freyung, Vienna. International Convention date, April 10, 1924.

To obtain perylene quinones, perylene dibromide is heated with concentrated sulphuric acid, the product poured into water, and the precipitate crystallised from glacial acetic acid.

232,265-6. Dyes. H. Pereira, 3, Freyung, Vienna. International Convention date, April 10, 1924.

232,265. Perylene Compounds are condensed with aluminium chloride in the presence of oxidising agents such as manganese peroxide, ferric oxide, ferric chloride, copper oxide, potassium nitrate and nickel sulphate. A number of examples are given showing that the nature of the dyestuff obtained is altered or the yield increased by the use of the oxidising agent.

232,266. Halogenated Perylenes are obtained by the action of nascent halogens. If certain oxidising agents are used to liberate the halogen, oxidised halogen compounds are obtained which are vat dyes. In an example, perylene is suspended in glacial acetic acid and brominated with hydrobromic acid and hydrogen peroxide. The oxidised bromo compound dyes cotton brown. Dichloro, tetrachloro, and pentachloro derivatives of perylene are obtained by treating a perylene suspension with hydrochloric acid and hydrogen peroxide, and oxidised chloroperylenes by treating with hydrochloric acid and potassium permanganate or manganese dioxide.

232,549. Refractory Oxides. T. R. Hagland, 8A[II], Drottningholmsgatan, Stockholm. International Convention date, April 17, 1924.

Alumina may be obtained from bauxite, clay, alundum, firebrick, felspar, alum, shale, leptite, etc., by fusing with coke, anthracite, charcoal or calcium carbide and a sulphur-containing substance such as pyrites, galena, copper pyrites, copper matte, sulphide of aluminium, calcium, barium, magnesium or sodium, or a mixture of a sulphate and sulphide. The reduced metals alloy with the silicon, and the alumina dissolves in the sulphide slag. The slag is treated with water, acid, alkali, or steam to dissolve or decompose the sulphide, leaving the alumina. If the slag contained aluminium sulphide, the action of water produces aluminium hydroxide which is mechanically separated from the crystalline alumina. The crystalline product can be further purified by electrostatic or electromagnetic treatment, and then by treating with acid and alkali. Other refractory oxides such as magnesia, chromium oxide, or zirconium oxide can be obtained in a similar manner.

232,560. Drying Calcium Hypochlorite. Chemische Fabrik Griesheim-Elektron, 31, Gutleutstrasse, Frankfort-on-Main, Germany. International Convention date, April 15, 1924.

Calcium hypochlorite is first treated by heat, with or without reduced pressure, and the remaining water is then combined with quicklime or other water-absorbing material. The water is principally removed by the heat treatment so that the available chlorine content is not greatly affected.

232,568. Hydrocarbons. Goldschmidt Akt.-Ges., 18, Salkenbergsweg, Essen, Germany. International Convention date, April 15, 1924.

Oil, such as a Pennsylvanian gas oil, is passed through a bath of molten lead at 650° C., yielding gases containing hydrocarbons of low molecular weight, particularly methane, ethylene, propylene and butylene. Undecomposed oil, benzenes and diolefines are removed by cooling, compression or absorption.

232,581. Iron Oxide and Sulphur Trioxide. Austral Pigments, Ltd., 86, Liverpool Street, Sydney, Australia. International Convention date, April 16, 1924.

Hydrated ferrous sulphate crystals are heated by gas flames in a rotary tube with a helical or other conveyor, so that the water of crystallisation is liberated above 64° C. and caking is prevented. The monohydrated sulphate is ground, oxidised by hot air to a basic ferric sulphate, and then calcined. The products are ferric oxide and sulphur trioxide.

232,599. Dyeing Cellulose Esters. Farbwerke vorm. Meister, Lucius, and Brüning, Hoechst-on-Main, Germany. International Convention date, April 15, 1924.

Cellulose esters are dyed with glycines of non-sulphonated aromatic bases, including basic dyestuffs containing a free

amino group. The compound may be diazotized on the fibre and developed. In examples, the material is treated with the glycine of α-naphthylamine, diazotized, and developed with β-oxynaphthoic acid, the colour being a violet-black; yellow is given by the glycine of aminoazobenzene, violet by the glycine of 1 : 4-diaminoanthraquinone, blue by the glycine of 1 : 4 : 5 : 8-tetraminoanthraquinone, and reddish-violet by the glycine of 1-amino-4-oxyanthraquinone.

232,610. Zinc Oxide. A. Forgeur, 35*bis*, Rue Jouffroy, Paris, and L. Grange, 32, Avenue de la Station, Vilvorde, Brussels. International Convention date, April 16, 1924.

Roasted blende is first treated with water to remove soluble sulphates, and then with ammonium chloride solution in an autoclave to dissolve the zinc. Copper is removed from the solution by means of zinc powder, and the solution is then poured into water to precipitate zinc hydroxide. The ammonium chloride is used again.

232,612. Synthetic Drugs. F. Lehnhoff-Wyld, 92, Rue Michel Ange, Paris. International Convention date, April 17, 1924.

Zinc chloride, or other metallic salt, is mixed with 3 : 3^1-diamino-4 : 4^1-dihydroxyarsenobenzene in methyl alcohol solution, and sodium formaldehyde-bisulphite then added. A yellow powder is precipitated, and is purified by adding acetic acid to its aqueous solution, and washing with alcohol. Alternatively, the arsenobenzene may first be converted into the methylene-sulphonate and then treated with the metallic salt.

232,618. Zinc pigments and Salts. P. Pipereaut, 8, Rue Abel, Paris, and A. Helbronner, 49, Rue St. Georges, Paris. International Convention date, April 18, 1924.

A mixture of zinc sulphate and sulphide is calcined to obtain a pigment of zinc oxide with or without zinc sulphide. If the molecular proportions of zinc sulphide to zinc sulphate are 1 : 3, the product is zinc oxide. If the proportions are 5 : 3, zinc oxysulphide, ZnO . ZnS, is obtained. Other pigments containing zinc oxide and titanium or antimony oxide, or barium or lead sulphate may be obtained in a similar manner.

232,629. Dyes. Akt.-Ges. für Anilin Fabrikation, Treptow, Berlin. International Convention date, April 19, 1924.

Sulphonated *o*-oxydiazo compounds are coupled with unsulphonated 1-naphthyl-3-methyl-5-pyrazolones, yielding monoazo dyes which give orange or bluish-red shades on wool with a chrome mordant. In one example, 1-β-naphthyl-3-methyl-5-pyrazolone is coupled with diazotized 4-nitro-2-aminophenol-6-sulphonic acid, or the barium salt of naphthalene-1 : 2-diazo-oxide-4 : 6-disulphonic acid.

Latest Notifications.

235,521. Process for the manufacture of ethyl chloride. Chemische Fabriken vorm. Weiler-Ter Meer. June 12, 1924.

235,540. Process for the preparation of carbocyclic ketones with more than nine ring members. Naef et Cie, M. June 16, 1924.

235,547. Process for the production of chlorine compounds of the lower homologues of ethylene. Goldschmidt, Akt.-Ges, T. June 10, 1924.

235,548. Process for the recovery of chromium as chromate from chromiferous waste materials. Mayer and Sohn, J. June 16, 1924.

235,550. Apparatus for the extraction of oils from fats. Krupp Grusonwerk Akt.-Ges, E. June 10, 1924.

235,552. Process for the production of ammonium chloride and alkali sulphate. Continentale Akt.-Ges. für Chemie. June 11, 1924.

235,556. Manufacture of sulphur dyestuffs. Akt.-Ges für Anilin-Fabrikation. June 14, 1924.

235,564. Methods of and apparatus for cracking and distilling oils. Motor Fuel Corporation. June 16, 1924.

235,584. Manufacture of halogenated alcohols. Farbenfabriken vorm. F. Bayer and Co. June 12, 1924.

235,588. Process of producing hydroxides and carbonates. Buchner, M. June 14, 1924.

235,598. Manufacture of new arylesters of nitro-amino sulphonic acids of the benzine series. Farbenfabriken vorm. F. Bayer and Co. June 14, 1924.

Specifications Accepted with Date of Application

211,125. Hydrogen and acetylene from methane or ethylene or from gaseous mixtures containing hydrocarbons of the methane or ethylene series, Manufacture or production of. F. Gros. February 8, 1923.

211,454 and 217,172. Absolute alcohol, Process of manufacture of. Ricard Allenet and Cie. February 15 and June 7, 1923. 217,172 addition to 211,454.

214,205. Puddled iron, Manufacture of. E. L. Ford. April 9, 1923.

215,734. Metallic vanadium, Method of producing. A. Wittig. May 7, 1923.

216,838. Acidyl celluloses, Process for dyeing. Farbenfabriken vorm. F. Bayer and Co. May 28, 1923.

217,554. Hydrocarbons from fuel, Process for evolving. C. B. Wisner. June 11, 1923.

219,322. Hydrocarbon oils, Purification of. J. Tausz. July 16, 1923.

219,706. Metals and metal alloys low in carbon, Methods for producing. H. G. Flodin. July 27, 1923.

223,918. Hydrogen cyanide, Manufacture of. Deutsche Gold und Silber-Scheideanstalt vorm. Roessler. December 2, 1922.

223,572. Pure oxide of zirconium, Process for the commercial production of. Soc. d'Etude des Agglomeres. October 17, 1923.

229,298. Ethyl chloride, Process for the manufacture of. H. Suida. February 11, 1924.

234,864. Shale, coal and other organic substances, Method of and apparatus for the recovery and fractional separation of the distillates of. A. G. Black. January 30, 1924.

234,928. Vat dyestuffs of the thioindigo series, Manufacture of. A. Carpmael and A. J. Ransford. (*L. Cassella and Co*) March 13, 1924.

234,933. Ammonium chloride, Method of producing white commercial pure. T. B. Smith and Simon Carves, Ltd. March 14, 1924.

234,950. Triphenylmethane-azo-dyestuffs, Manufacture of. O. Y. Imray. (*Soc. of Chemical Industry in Basle.*) April 7, 1924.

234,951. Oven for treating iron ores. J. G. Aarts. April 10, 1924.

234,956. Azo dyestuffs, Manufacture of. Soc. of Chemical Industry in Basle and H. Schobel. April 16, 1924. Addition to 191,305.

234,962. Dichlor-N-dihydro-1 : 2 : 2′ : 1′-anthraquinoneazine and process of making the same. A. Carpmael and A. J. Ransford. (*L. Cassella and Co.*) April 22, 1924.

235,007. Water gas from solid fuel, Process of and apparatus for producing. J. Rude. June 18, 1924.

235,015. Hexamethylene-tetramine, Manufacture of. H. Wade. (*S. Karpen and Bros.*) June 24, 1924.

235,020. Salt, Process for the recovery of. Salzbergwerk Neustassfurt and F. Crotogino. July 3, 1924.

235,044. Chlorhydrin solutions, Processes of making concentrated. E. C. R. Marks. (*Carbide and Carbon Chemicals Corporation.*) August 13, 1924.

Applications for Patents

Abbott Laboratories. Production of diacetoxymercuri-4-nitro-orthocresol. 15,976. June 20. (United States, July 2, 1924.)

American Rubber Co. Process of treating rubber latex, etc. 15,711. June 17. (United States, June 18, 1924.)

Badische Anilin and Soda-Fabrik and Johnson, J. Y. Catalytic oxidation of ammonia. 15,877. June 19.

British Cyanides Co., Ltd. Treatment of cotton, silk, etc. 15,927. June 19.

Cachemaille, A. S., and Westinghouse Lamp Co. Production and treatment of refractory metals. 15,895. June 19.

Cicali, G. Production of hydrogen. 15,526. June 15.

Cicali, G. Production of oxygen and nitrogen by distillation and rectification of air. 15,608. June 16.

Cicali, G. Apparatus for synthesis of ammonia. 15,710. June 17.

Dovan Chemical Corporation. Vulcanisation of rubber, etc. 15,712. June 17. (United States, February 7.)

Dunlop Rubber Co., Ltd., and Twiss, D. F., Vulcanisation of rubber. 15,902. June 19.

Huyghe, A. B. F. Centrifugal machines. 15,440. June 15.

Illingworth Carbonisation Co., Ltd., and Illingworth, S. R. Apparatus for manufacture of briquettes. 15,513. June 15.

Kirwan, J. H. Iron oxide. 15,831. June 19.

Lambert, C. F. J. Preventing formation of scale in steam-boilers, etc. 16,007. June 20.

Mallaba, H. J. Manufacture of cellulose acetate. 15,639. June 17.

May and Baker, Ltd., and Stickings, R. W. E. Manufacture of organic compounds of bismuth for therapeutic purposes. 15,934. June 19.

Ott, Adolph, Baron de, and Ruzicka, C. Alcohol fuel. 15,800. June 18.

Quick, A. S. Process for refining and decolorising oils and fats. 15,806. June 18.

Sandoz Chemical Works. Process of making allium preparations. 15,621. June 16. (Germany, June 17, 1924.)

Simon, A. Extraction of oils, fats, etc. 15,685. June 17.

Society of Chemical Industry in Basle. Manufacture of intermediate products and of dyestuffs therefrom. 15,512. June 15. (Switzerland, June 21, 1924.)

Varcoe, R. G. Manufacture of pottery. 15,556. June 16.

London Chemical Market

The following notes on the London Chemical Market are specially supplied to THE CHEMICAL AGE *by Messrs. R. W. Greeff & Co., Ltd., and Messrs. Chas. Page & Co., Ltd., and may be accepted as representing these firms' independent and impartial opinions.*

June 26, 1925.

TRADE generally this week has been better, and there is some little interest taken in contracts for the remainder of the year. Prices on the whole, are steady. Export demand is patchy, but from some quarters is quite active.

General Chemicals

ACETONE continues scarce and price should be taken at between £76 to £78 per ton.

ACID ACETIC is inclined to be more active, but the price is without change at £39 per ton for 80% Technical and £40 per ton for Pure.

ACID CITRIC continues lifeless and price is nominally without change at 1s. 5d. per lb.

ACID FORMIC is a bright spot and market is firm at £48 to £49 per ton for 85%.

ACID LACTIC is very active and the price is extremely firm at £43 per ton for 50% by weight.

ACID OXALIC is in moderately active request and price is unchanged at 3¾d. per lb.

ACID TARTARIC is quiet with nominal quotation at 11½d. per lb.; there is some export demand in evidence.

ALUMINA SULPHATE.—Only a moderate business is reported and 17/18% is quoted at £6 2s. 6d. to £6 7s. 6d. per ton ex warehouse; material is now inclined to be steadier.

ARSENIC is without feature and is quoted nominally at £24 to £25 per ton.

BARIUM CHLORIDE has been fairly active and the price is steady at £9 10s. to £9 15s. per ton.

CREAM OF TARTAR maintains its firmer tendency at from £75 to £79 per ton, according to quantity and make.

EPSOM SALTS is firm.

FORMALDEHYDE continues extremely quiet with price varying from £40 to £42 per ton, according to quantity and position.

LEAD ACETATE is quite active, and a substantial business has been done at £45 per ton for White and £43 per ton for Brown.

LIME ACETATE continues quiet with Grey at about £14 10s. per ton and Brown £9 10s. per ton.

METHYL ALCOHOL.—There is no demand and the nominal quotation is unchanged at £45 to £47 per ton, c.i.f.

POTASSIUM CAUSTIC.—88/92% is unchanged at about £29 to £30 per ton.

POTASSIUM CHLORATE continues scarce at 4½d. per lb.

POTASSIUM PERMANGANATE is quiet and can be obtained at 7½d. to 7¾d. per lb., ex warehouse.

POTASSIUM PRUSSIATE is extremely firm at 7½d. to 7¾d. per lb.; stocks are small.

SODA ACETATE is quiet, but price is maintained at £21 5s. to £21 10s. per ton.

SODA BICHROMATE is in active request at British makers' figures.

SODA HYPOSULPHITE.—Price is unchanged at about £9 10s. per ton for Commercial.

SODA PRUSSIATE seems to be firmer and there is a moderate demand at 4¼d. to 4½d. per lb.

SODA NITRITE has been fairly active at the current quotation of £22 15s. to £23 per ton.

SODA SULPHIDE.—British makers have made a substantial reduction in their price, Concentrated now being from £13 10s. to £14 10s. per ton, according to quantity and position. Crystals have also been substantially reduced and are now £8 15s. to £9 15s. per ton, but it is expected that these reductions will stimulate the demand.

Coal Tar Products

The general quiet tone of the market continues.

90% BENZOL is somewhat quiet, but the price remains unchanged at 1s. 8d. to 1s. 9d. per gallon on rails.

PURE BENZOL is quoted at 1s. 10d. to 1s. 11d. per gallon on rails.

CREOSOTE OIL is valued at 5½d. to 5¾d. per gallon on rails in the North, while the price in London is from 7d. to 7¼d. per gallon.

CRESYLIC ACID is weak, and is quoted at 1s. 7d. to 1s. 8d. per gallon on rails in bulk for the Pale quality 97/99%, while the Dark quality 95/97% is quoted at 1s. 5d. per gallon on rails.

SOLVENT NAPHTHA remains unchanged at 1s. 3d. to 1s. 4d. per gallon on rails.

HEAVY NAPHTHA is quoted at 1s. to 1s. 1d. per gallon on rails.

NAPHTHALENES remains unchanged, the lower grades being worth from £3 to £3 15s. per ton, while the 74/76 quality is quoted at £5 to £5 10s. per ton, and 76/78 quality at £5 15s. to £6 per ton.

PITCH.—There is nothing new to report. The market remains dull and prices are unchanged.

Latest Oil Prices

LONDON.—LINSEED OIL firm and 10s. to 12s. 6d. higher. Spot, £42 10s.; June, £41 7s. 6d.; July-August, £41 10s.; September-December, £41 12s. 6d. RAPE OIL quiet. Crude crushed, spot, £50 10s.; technical refined, £52 10s. COTTON OIL steady. Refined common edible, £47; Egyptian crude, £42 10s.; deodordised, £49. TURPENTINE firm and 9d. to 1s. 3d. per cwt. higher. American spot, 68s. 9d., and July-December, 69s. 3d.

HULL.—LINSEED OIL.—Naked, spot to September-December, £41 5s. COTTON OIL.—Naked, Bombay, crude, £38 10s. Egyptian crude, £41; edible refined, £45; deodorised, £47; technical, £41 10s. PALM KERNEL OIL.—Crushed, naked, 5½ per cent., £41 10s. GROUNDNUT OIL.—Crushed extracted, £48 10s.; deodorised, £52 10s. SOYA OIL.—Extracted and crushed, £42 10s.; deodorised, £45 10s. RAPE OIL.—Extracted, £49 per ton, net, cash terms, ex mill. CASTOR OIL and COD OIL unaltered.

Nitrogen Products Market

Export.—During the week the market has been unchanged and considerable business has been done for several countries on the basis of £11 10s. per ton f.o.b., single bags; producers are charging an extra 12s. 6d. per ton for double bags. The usual steady demand has come from the Continent, but the West Indies and the Far East have also been purchasers. For forward positions higher prices are being quoted and sales have been made for useful quantities.

Home.—The home demand continues to be quiet as usual for this time of the year; deliveries are taking place of the large sales made to fertiliser manufacturers for the summer months. These sales are considerably in excess of those made for last year. As a consequence of the demand abroad and the large sales to mixers at home, the statistical position of the producers appears to be strong enough to enable them to carry through their policy of steadily raising prices as the season advances.

Nitrate of Soda.—The nitrate of soda market continues firm, the price is unchanged at about £11 17s. 6d. per ton c.i.f. chief European ports. The prices are practically the same for the 1925-26 season, but whether the scale can be carried out is very difficult to foresee. The position in Chile is obscure; it is understood that negotiations are taking place between the Directorate and the Chilian Government with a view to a reduction in the tax on nitrate. Labour troubles are not at an end and these may have a considerable effect on the coming year's production. The consumption of nitrate has advanced in the last two or three years and there seems no reason to assume that the market cannot take a slightly reduced production at present prices.

American Market Movements

(FROM *Drug and Chemical Markets.*)

STEADY movement in industrial chemicals continues with spot trading a slight improvement in some quarters. Prices are steady practically without exception. Prices in fine chemicals show few changes over a week of exceptionally quiet trading. Quicksilver, codliver oil and menthol continue strong with camphor weaker. Light oil distillates very firm at recent prices, and supplies are not plentiful. Pyridine declines sharply as buying ceases. Intermediates moving in a routine manner. Vegetable oils in unsettled condition. Linseed oil down. Chinawood oil steady. Cottonseed oil unsettled. Animal oils record only slight changes.

Weekly Prices of British Chemical Products

The prices and comments given below respecting British chemical products are based on direct information supplied by the British manufacturers concerned. Unless otherwise qualified, the figures quoted apply to fair quantities, net and naked at retailers' works.

General Heavy Chemicals

Acid Acetic, 40% Tech.—£21 to £23 per ton.

Acid Boric, Commercial.—Crystal, £40 per ton, Powder, £42 per ton.

Acid Hydrochloric.—3s. 9d. to 6s. per carboy d/d., according to purity, strength and locality.

Acid Nitric, 80° Tw.—£21 10s. to £27 per ton, makers' works, according to district and quality.

Acid Sulphuric.—Average National prices f.o.r. makers' works, with slight variations up and down owing to local considerations: 140° Tw., Crude Acid, 65s. per ton. 168° Tw., Arsenical, £5 10s. per ton. 168° Tw., Non-arsenical, £6 15s. per ton.

Ammonia Alkali.—£6 15s. per ton f.o.r. Special terms for contracts.

Bleaching Powder.—Spot, £10 10s. d/d; Contract, £10 d/d. 4 ton lots.

Bisulphite of Lime.—£7 10s. per ton, packages extra, returnable.

Borax, Commercial.—Crystal, £25 per ton. Powder, £26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain.)

Calcium Chlorate (Solid).—£5 12s. 6d. to £5 17s. 6d. per ton d/d, carriage paid.

Copper Sulphate.—£25 to £25 10s. per ton.

Methylated Spirit 64 O.P.—Industrial, 2s. 7d. to 2s. 11d. per gall. Mineralised, 3s. 8d. to 4s. per gall., in each case according to quantity.

Nickel Sulphate.—£38 per ton d/d.

Nickel Ammonia Sulphate.—£38 per ton d/d.

Potash Caustic.—£30 to £33 per ton.

Potassium Bichromate.—5d. per lb.

Potassium Chlorate.—2¾d. to 3d. per lb.

Salammoniac.—£45 to £50 per ton d/d. Chloride of ammonia, £37 to £45 per ton. Carr. pd.

Salt Cake.—£3 15s. to £4 per ton d/d. In bulk.

Soda Caustic, Solid.—Spot lots delivered, £15 12s. 6d. to £18 per ton, according to strength; 20s. less for contracts.

Soda Crystals.—£5 to £5 5s. per ton ex railway depots or ports.

Sodium Acetate 97/98%.—£24 per ton.

Sodium Bicarbonate.—£10 10s. per ton, carr. paid.

Sodium Bichromate.—4d. per lb.

Sodium Bisulphite Powder 60/62%.—£16 to £17 per ton, according to quantity, f.o.b., 1-cwt. iron drums included.

Sodium Chlorate.—2¾d. per lb.

Sodium Nitrate refined 96%.—£13 5s. to £13 10s. per ton, ex Liverpool.

Sodium Nitrite 100% basis.—£27 per ton d/d.

Sodium Sulphate (Glauber Salts).—£3 12s. 6d. per ton.

Sodium Sulphide conc. solid. 60/65.—£15 per ton d/d. Contract £14 15s. Carr. pd.

Sodium Sulphide Crystals.—£9 5s. per ton d/d. Contract £9 2s. 6d. Carr. pd.

Sodium Sulphide, Pea Crystals.—£15 per ton f.o.r. London, 1-cwt. kegs included.

Coal Tar Products

Acid Carbolic Crystals.—4½d. to 4¾d. per lb., according to quantity. Quiet demand. Crude 60's, 1s. 6d. per gall.

Acid Cresylic 97/99.—1s. 8d. to 2s. per gall. Fair business. Pale, 95%, 1s. 6d. per gall. Dark, 1s. 6d. to 1s. 9d. per gall. Slightly better demand.

Anthracene Paste 40%.—3d. per unit per cwt.—Nominal price. No business.

Anthracene Oil, Strained.—7d. to 8d. per gall. Unstrained, 6d. to 7d. per gall.

Benzol.—Crude 65's.—8d. to 9d. per gall., ex works in tank wagons. Standard Motor, 1s. 7½d. to 1s. 8½d. per gall., ex works in tank wagons. Pure, 1s. 9½d. to 1s. 11½d. per gall., ex works in tank wagons.

Toluol.—90%, 1s. 7d. to 1s. 9d. per gall. More inquiry. Pure, 1s. 9½d. to 1s. 11½d. per gall. Quiet.

Xylol Commercial.—2s. 3d. per gall. Pure, 3s. 3d. per gall.

Creosote.—Cresylic, 20/24%, 8d. per gall. Standard specification, 6d. to 6½d. per gall. Fair business.

Naphtha.—Crude, 8d. to 9d. per gall. Solvent 90/160, 1s. 5d. to 1s. 6d. per gall. Demand good. Solvent 90/190, 1s. to 1s. 4d. per gall. Steady.

Naphthalene Crude.—Drained Creosote Salts, £2 10s. to £3 per ton. Market quiet. Whizzed or hot pressed, £6 to £9 per ton.

Naphthalene.—Crystals and Flaked, £10 to £11 per ton, according to districts. Very quiet.

Pitch.—Medium soft, 40s. per ton, according to district. No business until next season.

Pyridine.—90/160, 19s. per gall. Heavy, 11s. 6d. to 12s. per gall.

Intermediates and Dyes

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%.—1s. 7d. per lb.

Acid H.—3s. 9d. per lb. 100% basis d/d.

Acid Naphthionic.—2s. 2d. per lb. 100% basis d/d.

Acid Neville and Winther.—5s. 8d. per lb. 100% basis d/d.

Acid Salicylic, technical.—11d. to 11½d. per lb. Steady demand.

Acid Sulphanilic.—9d. per lb. 100% basis d/d.

Aluminium Chloride, anhydrous.—10d. per lb. d/d.

Aniline Oil.—7½d. per lb. naked at works.

Aniline Salts.—8d. per lb. naked at works.

Antimony Pentachloride.—1s. per lb. d/d.

Benzidine Base.—3s. 8d. per lb. 100% basis d/d.

Benzyl Chloride 95%.—1s. 1d. per lb.

p-Chlorphenol.—4s. 3d. per lb. d/d.

p-Chloraniline.—3s. per lb. 100% basis.

o-Cresol 29/31° C.—3d. per lb. Demand quiet.

m-Cresol 98/100%.—2s. 1d. per lb. Demand moderate.

p-Cresol 32/34° C.—2s. 1d. per lb. Demand moderate.

Dichloraniline.—2s. 3d. per lb.

Dichloraniline S. Acid.—2s. 3d. per lb. 100% basis.

Diethylaniline.—4s. 3d. per lb. d/d., packages extra, returnable.

Dimethylaniline.—2s. 2d. per lb. d/d. Drums extra.

Dinitrobenzene.—9d. per lb. naked at works.

Dinitrochlorbenzol.—£84 10s. per ton d/d.

Dinitrotoluene.—48/50° C. 8d. to 9d. per lb. naked at works. 66/68° C. 1s. per lb. naked at works.

Diphenylaniline.—2s. 10d. per lb. d/d.

G. Salt.—2s. 2d. per lb. 100% basis d/d.

a-Naphthol.—2s. 3d. per lb. d/d.

B-Naphthol.—1s. per lb. d/d.

a-Naphthylamine.—1s. 3½d. per lb. d/d.

B-Naphthylamine.—3s. 9d. per lb. d/d.

m-Nitraniline.—4s. 2d. per lb. d/d.

p-Nitraniline.—2s. 2d. per lb. d/d.

Nitrobenzene.—5½d. to 5¾d. per lb. naked at works.

o-Nitrochlorbenzol.—2s. 3d. per lb. 100% basis d/d.

Nitronapthalene.—10d. per lb. d/d.

p-Nitrophenol.—1s. 9d. per lb. 100% basis d/d.

p-Nitro-*o*-amido-phenol.—4s. 6d. per lb. 100% basis.

m-Phenylene Diamine.—4s. per lb. d/d.

p-Phenylene Diamine.—9s. 9d. per lb. 100% basis d/d.

R. Salt.—2s. 4d. per lb. 100% basis d/d.

Sodium Naphthionate.—2s. 2d. per lb. 100% basis d/d.

o-Toluidine.—10d. per lb.

p-Toluidine.—2s. 3d. per lb. naked at works.

m-Toluylene Diamine.—4s. per lb. d/d.

Wood Distillation Products

Acetate of Lime.—Brown £9 10s. to £10. Quiet market. Grey, £15 per ton. Liquor, 9d. per gall. 32° Tw.

Acetone.—£73 per ton.

Charcoal.—£7 5s. to £8 10s. per ton, according to grade and locality.

Iron Liquor.—1s. 7d. per gall. 32° Tw. 1s. 2d. per gall. 24° Tw.

Red Liquor.—10d. to 1s. per gall. 14/15° Tw.

Wood Creosote.—2s. 9d. per gall. Unrefined.

Wood Naphtha, Miscible.—4s. 3d. per gall. 60% O.P. Solvent, 4s. 6d. per gall. 40% O.P.

Wood Tar.—£4 per ton.

Brown Sugar of Lead.—£43 per ton.

Rubber Chemicals

Antimony Sulphide.—Golden, 7½d. to 1s. 5d. per lb., according to quality. Crimson, 1s. 5d. to 1s. 7½d. per lb., according to quality.

Arsenic Sulphide, Yellow.—2s. per lb.

Barytes.—£3 10s. to £6 15s. per ton, according to quality.

Cadmium Sulphide.—4s. 4d. per lb.

Carbon Bisulphide.—£32 to £35 per ton, according to quantity.

Carbon Black.—6d. to 6½d. per lb., ex wharf.

Carbon Tetrachloride.—£62 to £67 per ton, according to quantity, drums extra.

Chromium Oxide, Green.—1s. 4d. per lb.

Indiarubber Substitutes, White and Dark.—5¾d. to 7½d. per lb.

Lamp Black.—£48 per ton, barrels free.

Lead Hyposulphite.—9d. per lb.

Lithopone, 30%.—£22 10s. per ton.

Mineral Rubber "Rubpron."—£16 to £18 per ton f.o.r. London.

Sulphur.—£10 to £12 per ton, according to quality.

Sulphur Chloride.—4d. per lb., carboys extra.

Sulphur Precip. B.P.—£56 to £65 per ton.

Thiocarbanilide.—2s. 6d. per lb.
Vermilion, Pale or Deep.—5s. 6d. per lb.
Zinc Sulphide.—1s. 1d. per lb.

Pharmaceutical and Photographic Chemicals

Acid, Acetic 80% B.P.—£40 per ton ex wharf London in glass containers.
Acid, Acetyl Salicylic.—2s. 8d. to 2s. 10d. per lb. British makers meeting foreign competition in quality and price.
Acid, Benzoic B.P.—2s. to 2s. 3d. per lb., according to quantity.
Acid, Boric B.P.—Crystal £46 per ton, Powder £50 per ton. Carriage paid any station in Great Britain.
Acid, Camphoric.—19s. to 21s. per lb.
Acid, Citric.—1s. 4d. to 1s. 4½d. per lb., less 5% for ton lots. Seasonable demand increasing.
Acid, Gallic.—2s. 9d. per lb. for pure crystal, in cwt. lots.
Acid, Pyrogallic, Crystals.—6s. per lb. for 1 cwt. lots. 7s. 6d. per lb. for 7-lb. lots, according to quantity.
Acid, Salicylic.—1s. 3d. to 1s. 8d. per lb., according to quantity. Good demand.
Acid, Tannic B.P.—2s. 9d. per lb.
Acid, Tartaric.—11½d. per lb., less 5%.
Amidol.—9s. per lb., d/d.
Acetanilide.—1s. 7d. per lb. for quantities.
Amidopyrin.—13s. 9d. per lb.
Ammonium Benzoate.—3s. 3d. to 3s. 6d. per lb., according to quantity.
Ammonium Carbonate B.P.—£37 per ton. Powder, £39 per ton in 5 cwt. casks.
Atropine Sulphate.—12s. 6d. per oz. for English make.
Barbitone.—11s. 6d. per lb.
Benzonaphthol.—3s. 5d. to 4s. per lb. spot.
Bismuth Carbonate.—10s. 6d. to 12s. 6d. per lb.
Bismuth Citrage.—10s. 3d. to 12s. 3d. per lb.
Bismuth Salicylate.—9s. to 11s. per lb.
Bismuth Subnitrate.—8s. 8d. to 10s. 8d. per lb.
(Supplies of the metal are still restricted.)
according to quantity.
Borax B.P.—Crystal £29, Powder £30 per ton. Carriage paid any station in Great Britain.
Bromides.—Potassium, 1s. 11d. to 2s. 1d. per lb.; sodium, 2s. 1d. to 2s. 2d. per lb.; ammonium, 2s. 4d. to 2s. 6d. per lb., all spot. British or Imported.
Calcium Lactate.—1s. 6½d. to 1s. 8d., according to quantity.
Chloral Hydrate.—3s. 6d. per lb., duty paid.
Chloroform.—2s. 5½d. to 2s. 7½d. per lb., less 2½% according to quantity.
Creosote Carbonate.—6s. 9d. per lb.
Formaldehyde.—£40 per ton, in barrels ex wharf.
Glycerophosphates.—Fair business passing. Calcium, soluble and citrate free, 7s. per lb.; iron, 8s. 9d. per lb.; magnesium, 9s. per lb.; potassium, 50%, 3s. 6d. per lb.; sodium, 60%, 2s. 6d. per lb.
Guaiacol Carbonate.—7s. to 7s. 3d. per lb.
Hexamine.—2s. 5d. to 2s. 6d. per lb. for cwt. lots.
Homatropine Hydrobromide.—30s. per oz.
Hydrastine Hydrochloride.—English make offered at 120s. per oz.
Hydrogen Peroxide (12 vols.).—1s. 8d. per gallon f.o.r. makers' works, naked.
Hydroquinone.—4s. 3d. per lb. Nominal.
Hypophosphites.—Calcium, 3s. 6d. per lb., for 28 lb. lots; potassium, 4s. 1d. per lb.; sodium, 4s. per lb.
Iron Ammonium Citrate B.P.—1s. 11d. to 2s. 3d. per lb. Green, 2s. 6d. to 2s. 11d. per lb. U.S.P., 2s. to 2s. 2d. per lb.
Magnesium Carbonate.—Light Commercial, £34 per ton net. Light pure, £46 per ton.
Magnesium Oxide.—Light Commercial, £70 per ton, less 2½%, price reduced; Heavy Commercial, reduced to £24 per ton, less 2½%; Heavy Pure, 2s. to 2s. 3d. per lb., according to quantity.
Menthol.—A.B.R. recrystallised B.P., 43s. per lb.; June delivery. Synthetic, 22s. 6d. to 27s. 6d. per lb., according to quality. English make.
Mercurials.—Red oxide, 5s. 2d. to 5s. 4d. per lb.; Corrosive sublimate, 3s. 7d. to 3s. 9d. per lb.; white precipitate, 4s. 6d. to 4s. 8d. per lb.; Calomel, 3s. 10d. to 4s. per lb.
Methyl Salicylate.—1s. 5½d. to 1s. 8d. per lb., according to quantity.
Methyl Sulphonal.—18s. to 18s. 6d. per lb.
Metol.—11s. per lb. British make.
Paraformaldehyde.—2s. for B.P. quality.
Paraldehyde.—1s. 4½d. per lb., in free bottles and cases.
Phenacetin.—4s. 3d. per lb. in cwt. lots. Slightly cheaper.
Phenazone.—6s. 3d. per lb.
Phenolphthalein.—4s. 3d. to 4s. 6d. per lb. for cwt. lots.
Potassium Bitartrate 99/100% (Cream of Tartar).—83s. per cwt., less 2½% for ton lots.
Potassium Citrate.—1s. 10d. to 2s. 2d. per lb.
Potassium Ferricyanide.—1s. 9d. per lb. Quiet.
Potassium Iodide.—16s. 8d. to 16s. 11d. per lb., according to quantity. Steady market.
Potassium Metabisulphite.—7½d. per lb., 1-cwt. kegs included, f.o.r. London.
Potassium Permanganate.—B.P. crystals, 7½d. per lb., spot.
Quinine Sulphate.—2s. 3d. to 2s. 4d. per oz., in 100 oz. tins. Steady market.
Resorcin.—4s. 5d. per lb. In fair quantities.
Saccharin.—63s. per lb. in 50 lb. lots.
Salol.—3s. 6d. per lb., for cwt. lots.
Silver Proteinate.—12s. per lb. for satisfactory product light in colour.
Sodium Benzoate, B.P.—1s. 10d. to 2s. 2d. per lb.
Sodium Citrate, B.P.C., 1911.—1s. 7d. to 2s. per lb., according to quantity. U.S.P. 1s. 10d. to 2s. 2d. per lb.
Sodium Hyposulphite, Photographic.—£14 to £15 per ton, according to quantity, d/d consignee's station in 1-cwt. kegs.
Sodium Metabisulphite Crystals.—37s. 6d. to 60s. per cwt., net cash, according to quantity.
Sodium Nitroprusside.—16s. per lb.
Sodium Potassium Tartrate (Rochelle Salt).—75s. per cwt., for ton lots and upwards.
Sodium Salicylate.—Powder, 2s. to 2s. 6d. per lb. Crystal, 2s. to 2s. 4d. per lb. Flake, 2s. 3d. per lb. Strong demand.
Sodium Sulphide, pure recrystallised.—10d. to 1s. 2d. per lb.
Sodium Sulphite, anhydrous, £27 10s. per ton, minimum 5 ton lots, according to quantity; 1-cwt. kegs included.
Sulphonal.—12s. 8d. per lb.
Thymol.—17s. per lb.

Perfumery Chemicals

Acetophenone.—9s. 6d. per lb.
Aubepine (ex Anethol).—10s. per lb.
Amyl Acetate.—3s. per lb.
Amyl Butyrate.—6s. 6d. per lb.
Amyl Salicylate.—3s. 1½d. per lb.
Anethol (M.P. 21/22° C.).—5s. per lb.
Benzyl Acetate from Chlorine-free Benzyl Alcohol.—2s. 6d. per lb.
Benzyl Alcohol free from Chlorine.—2s. 6d. per lb.
Benzaldehyde free from Chlorine.—3s. per lb.
Benzyl Benzoate.—3s. per lb.
Cinnamic Aldehyde Natural.—14s. 9d. per lb.
Coumarin.—14s. 6d. per lb.
Citronellol.—20s. per lb.
Citral.—8s. 6d. per lb.
Ethyl Cinnamate.—9s. per lb.
Ethyl Phthalate.—3s. per lb.
Eugenol.—10s. per lb.
Geraniol (Palmarosa).—28s. 6d. per lb.
Geraniol.—9s. 6d. to 18s. 6d. per lb.
Heliotropine.—6s. 3d. per lb.
Iso Eugenol.—14s. 6d. per lb.
Linalol ex Bois de Rose.—21s. per lb.
Linalyl Acetate.—20s. per lb.
Methyl Anthranilate.—10s. per lb.
Methyl Benzoate.—5s. per lb.
Musk Ambrette.—50s. per lb.
Musk Ketone.—34s. 6d. per lb.
Musk Xylol.—9s. 9d. per lb.
Nerolin.—4s. 6d. per lb.
Phenyl Ethyl Acetate.—15s. per lb.
Phenyl Ethyl Alcohol.—13s. 6d. per lb.
Rhodinol.—38s. 6d. per lb.
Safrol.—1s. 8d. per lb.
Terpineol.—1s. 10d. per lb.
Vanillin.—25s. to 25s. 6d. per lb.

Essential Oils

Almond Oil, Foreign S.P.A.—13s. 3d. per lb.
Anise Oil.—2s. 9d. per lb.
Bergamot Oil.—15s. 9d. per lb.
Bourbon Geranium Oil.—18s. per lb.
Camphor Oil.—60s. per cwt.
Cananga Oil, Java.—11s. 3d. per lb.
Cinnamon Oil, Leaf.—6d. per oz.
Cassia Oil, 80/85%.—9s. 3d. per lb.
Citronella Oil.—Java, 85/90%, 4s. 6d. per lb. Ceylon, 2s. 10d. to 3s. per lb., according to quality.
Clove Oil.—7s. 6d. per lb.
Eucalyptus Oil, 70/75%.—2s. per lb.
Lavender Oil.—French 38/40% Esters, 31s. 6d. per lb.
Lemon Oil.—4s. 9d. per lb. Advanced again.
Lemongrass Oil.—5s. 3d. per lb.
Orange Oil, Sweet.—10s. 9d. per lb.
Palma Rose Oil.—15s. 3d. per lb.
Otto of Rose Oil.—Bulgarian, 45s. per oz. Anatolian, 23s. 6d. per oz
Palma Rosa Oil.—15s. 6d. per lb.
Peppermint Oil.—Wayne County. No good quality materials available on spot; 85s. to 102s. per lb. asked for shipment. Japanese, 16s. 3d. per lb.
Petitgrain Oil.—9s. per lb.
Sandal Wood Oil.—Mysore, 26s. per lb Australian, 18s. 6d. per lb.

Scottish Chemical Market

The following notes on the Scottish Chemical Market are specially supplied to THE CHEMICAL AGE *by Messrs. Charles Tennant and Co., Ltd., Glasgow, and may be accepted as representing the firm's independent and impartial opinions.*

Glasgow, June 26, 1925.

THE heavy chemical market continues fairly quiet and there is no change of any importance to record.

Industrial Chemicals

ACID ACETIC.—In moderate request and price unchanged. 98/100% glacial, £56 to £67 per ton according to quality and packing, c.i.f. U.K. ports; 80% pure, £40 to £42 per ton; 80% technical, £39 to £41 per ton, packed in casks, c.i.f. U.K. ports.

ACID BORIC.—Crystal, granulated or small flaked, £40 per ton; powdered, £42 per ton, packed in bags, carriage paid U.K. stations, minimum ton lots.

ACID CARBOLIC ICE CRYSTALS.—Nominally 4½d. per lb. delivered, but could probably be obtained for less.

ACID CITRIC, B.P. CRYSTALS.—Now quoted 1s. 4½d. per lb. less 5%, ex store. Offered for prompt shipment at a fraction less.

ACID FORMIC, 85%.—Unchanged at about £49 10s. per ton, ex store. Offered for prompt shipment from the continent at £48 per ton, c.i.f. U.K. ports.

ACID HYDROCHLORIC.—In little demand. Price 6s. 6d. per carboy, ex works.

ACID NITRIC, 80°.—Usual steady demand, quoted £23 15s. per ton, ex station, full truck loads.

ACID OXALIC, 98/100%.—In moderate demand and price unchanged at 3¾d. per lb., ex store, spot delivery. Offered for prompt shipment at about 3½d. per lb., c.i.f. U.K. ports.

ACID SULPHURIC.—144°, £3 12s. 6d. per ton; 168°, £7 per ton, ex works, full truck loads. Dearsenicated quality, 20s. per ton more.

ACID TARTARIC, B.P. CRYSTALS.—Rather better demand and price now 1s. 0½d. per lb., less 5%, ex store. Offered for prompt shipment at about 1s. per lb., less 5%, ex wharf.

ALUMINA SULPHATE, 17/18%, IRON FREE.—Spot lots quoted £6 10s. per ton, ex store. Offered for prompt shipment from the continent at about £6 5s. per ton, c.i.f. U.K. ports.

ALUM, LUMP POTASH.—Quoted £9 5s. per ton, ex store. Offered from the continent at £8 per ton, c.i.f. U.K. ports.

AMMONIA ANHYDROUS.—In better demand. Price unchanged at about 1s. 4½d. per lb., ex station. Containers extra and returnable.

AMMONIA CARBONATE.—Lump, £37 per ton; powdered, £39 per ton. Packed in 5 cwt. casks, delivered U.K. ports.

AMMONIA LIQUID, 880°.—In steady demand. Unchanged at 2½d. to 3d. per lb. delivered, according to quantities.

AMMONIA MURIATE.—Grey galvaniser's crystals of English manufacture quoted £28 10s. per ton, ex station. Offered from the continent at about £24 10s. per ton, c.i.f. U.K. ports. Fine white crystals on offer at £19 15s. per ton, c.i.f. U.K. ports.

ARSENIC.—Refined white Cornish, quoted £25 per ton, ex wharf, early delivery. Spot lots about £26 per ton, ex store. Foreign arsenic still on offer at about £23 per ton, c.i.f. U.K. ports.

BARIUM CARBONATE, 98/100%.—Quoted £7 10s. per ton, c.i.f. U.K. ports, prompt shipment.

BARIUM CHLORIDE, 98/100%.—English material unchanged at about £10 5s. per ton, ex store. Offered from the continent at £8 10s. per ton, c.i.f. U.K. ports.

BLEACHING POWDER.—Spot lots quoted £10 10s. per ton, ex station. Contracts 20s. per ton less.

BARYTES.—English material unchanged at £5 5s. per ton, ex works. Continental quoted £5 per ton, c.i.f. U.K. ports.

BORAX.—Granulated, £24 10s. per ton; crystals, £25 per ton; powdered, £26 per ton, carriage paid U.K. stations, minimum ton lots.

CALCIUM CHLORIDE.—In good demand and price unchanged at £5 12s. 6d. to £5 17s. 6d. per ton, carriage paid for English material. Continental quoted about £3 15s. per ton, c.i.f. U.K. ports.

COPPERAS, GREEN.—Unchanged at about £3 5s. per ton, ex works, packed in casks free.

COPPER SULPHATE.—Quoted £24 10s. per ton, f.o.b. U.K. ports for export. Continental available at about £23 per ton, ex store.

FORMALDEHYDE 40%.—Quoted £40 10s. per ton, ex store, spot delivery. Offered for prompt shipment at about £39 per ton, c.i.f. U.K. ports.

GLAUBER SALTS.—Quoted £4 per ton, ex store, for English material Continental on offer at about £3 per ton, c.i.f. U.K. ports.

LEAD, RED.—Imported material unchanged at about £42 to £42 10s. per ton, ex store. Offered from the continent at about £39 10s. per ton, c.i.f. U.K. ports.

LEAD, WHITE.—Quoted £43 per ton, ex store, spot delivery.

LEAD ACETATE.—White crystals quoted £44 5s. per ton, ex store, spot delivery. Brown quality £43 per ton. White crystals offered from the continent, £43 5s. per ton, c.i.f. U.K. port. Brown, about £37 per ton, c.i.f. U.K. ports.

LEAD NITRATE.—Unchanged at about £42 10s. per ton, ex station.

MAGNESITE, GROUND CALCINED.—Usual steady demand, and prices unchanged at about £8 per ton, ex station.

MAGNESIUM CHLORIDE.—Offered for prompt shipment at £5 per ton, c.i.f. U.K. ports. Some spot material still available at below this figure.

POTASH CAUSTIC, 88/92%.—Unchanged at about £29 per ton, ex wharf, prompt shipment from the continent. Spot material available at about £30 10s. per ton, ex store.

POTASSIUM BICHROMATE.—Price for home consumption, 5d. per lb., delivered.

POTASSIUM CARBONATE, 96/98%.—Continental prices slightly higher. Now quoted £25 10s. per ton, c.i.f. U.K. ports. Spot material still available at about £26 per ton, ex store.

POTASSIUM CHLORATE.—Still scarce for early delivery. Some available at about 3¾d. per lb., c.i.f. U.K. ports. Spot material quoted 4d. per lb., ex store.

POTASSIUM NITRATE, SALTPETRE.—Refined granulated 99% quoted at about £28 per ton, ex store. Quoted £24 10s. per ton, c.i.f. U.K. ports for prompt shipment from the continent.

POTASSIUM PERMANGANATE, B.P. CRYSTALS.—On offer at 7½d. per lb., ex store. Offered for prompt shipment from the continent at about 7¼d. per lb., ex wharf.

POTASSIUM PRUSSIATE, YELLOW.—In little demand, quoted 7d. to 7¼d. per lb., ex store.

SODA CAUSTIC, 76/77%.—£18 per ton; 70/72%, £16 12s. 6d. per ton. Broken, 60%, £17 2s. 6d. per ton. Powdered, 98/99%, £21 7s. 6d. per ton. All carriage paid U.K. stations, spot delivery. Contracts 20s. per ton less.

SODIUM ACETATE.—Cheaper quotations from the continent quoted £18 per ton, c.i.f. U.K. ports. Spot material offered at £20 15s. per ton, ex store.

SODIUM BICARBONATE.—Refined re-crystallised quality, £10 10s. per ton, ex quay or station. M.W. quality, 30s. per ton less.

SODIUM CARBONATE.—Soda crystals, £5 to £5 5s. per ton, ex quay or station. Powdered or pea quality, £1 7s. 6d. per ton more. Alkali, 58%, £8 12s. 3d. per ton, ex quay or station.

SODIUM HYPOSULPHITE.—Commercial quality offered from the continent at £8 5s. per ton, c.i.f. U.K. ports. English material unchanged at £9 10s. per ton, ex station. Pea crystals, £14 per ton, ex station.

SODIUM NITRATE.—Quoted £13 per ton, ex store; 96/98%, refined quality, 7s. 6d. per ton extra.

SODIUM NITRITE, 100%.—Spot material now offered at £24 per ton, ex store. Quoted £22 per ton, c.i.f. U.K. ports.

SODIUM PRUSSIATE, YELLOW.—In little demand. Nominally 4d. per lb., ex store, but could be obtained for less.

SODIUM SULPHATE, SALTCAKE.—Price for home consumption, £3 10s. per ton, f.o.r. works. Good inquiry for export and higher prices obtainable.

SODIUM SULPHIDE.—English manufacturers quote 60/62%. Solid, £15 per ton. Broken, £1 per ton more. Flake, £2 per ton more. Crystal, 31/34%, £9 5s. per ton, carriage paid U.K. stations; minimum 4-ton lots, with slight reduction for contracts over a period; 60/62%, solid, offered from the continent at about £10 15s. per ton, c.i.f. U.K. ports. Broken, £1 per ton more; 30/32%, crystals, £8 5s. per ton, c.i.f. U.K. ports.

SULPHUR.—Flowers, £9 10s. per ton; roll, £8 10s. per ton; rock, £8 7s. 6d. per ton; ground, £8 5s. per ton—ex store, prices nominal.

ZINC CHLORIDE, 98/100%.—Quoted from the continent at £24 5s. per ton, c.i.f. U.K. ports; 97/98%, of English manufacture, on offer at £25 per ton, f.o.b. U.K. ports.

ZINC SULPHATE.—Commercial crystals on offer from the continent at about £12 per ton, c.i.f. U.K. ports.

NOTE.—The above prices are for bulk business, and are not to be taken as applicable to small parcels.

Coal Tar Intermediates and Wood Distillation Products

ORTHOANISIDINE.—8s. per lb., fair export inquiries.

ALPHA NAPHTHYLAMINE.—1s. 2d. to 1s. 3d., fair home inquiries.

CLEVES ACID, 2s. 9d. per lb., per 100%, fair home inquiries.

BENZALDEHYDE, 2s. 2d. per lb., some home inquiries.

AMIDO NAPHTHOL SULPHO ACID, 1, 8, 4—10s. 3d. per lb., per 100%. Some home inquiries.

The Manchester Chemical Market

[From Our Own Correspondent.]

Manchester, June 26, 1925.

Chemical traders in the Manchester district have to be content with a volume of business which is very much below what, in the past, they were wont to regard as normal. The demand for chemicals for home needs and for export keeps quiet and most of the transactions continue to be for small or moderate sized parcels for prompt or early delivery, buyers in few instances showing little inclination to commit themselves very far ahead.

Heavy Chemicals

A fair demand for hyposulphite of soda is being met with; photographic crystals are currently quoted at £13 10s. to £13 15s. per ton, with commercial quality offering at about £9. Soda crystals keep steady at £5 5s. per ton, a fair volume of business being put through. Saltcake is in moderate request and prices are unchanged at £3 12s. 6d. to £3 15s. per ton. Glauber salts are easy at about £3 10s. and little buying interest in this material is being displayed. Alkali is firm and in quietly steady demand at £6 15s. per ton. Sulphide of sodium is steady and in moderate inquiry at £13 15s. to £14 per ton for 60-65 per cent. concentrated solid and round £9 10s. per ton for crystals. Phosphate of soda is quiet but unchanged from last week at £12 10s. to £12 15s. per ton. Caustic soda still attracts a fair amount of attention and quotations are steady at from £15 12s. 6d. per ton for 60 per cent. material to £18 for 76-77 per cent. Prussiate of soda is a shade more active and values are firm at 4d. per lb. Bicarbonate of soda is maintained at £10 10s. per ton but sales are rather slow. Bleaching powder is comparatively dull at £9 10s. per ton. Chlorate of soda is steady and meets with a moderate demand at round 3d. per lb. Acetate of soda keeps quiet at about £19 10s. per ton.

Caustic potash and carbonate of potash are selling in relatively small quantities and slightly easier values are being quoted; caustic is quoted at round £29 per ton and carbonate at £24 10s. Chlorate of potash is firm and in moderate request at 3¾d. per lb. Bichromate of potash is steady at 5d. per lb. but business is on the slow side. Prussiate of potash is well maintained at the recent level of 7d. per lb. Permanganate of potash is quiet but steady at about 6¼d. per lb. for commercial and 8d. for B.P. quality.

Arsenic continues to sell slowly and prices are easy though still between £25 and £26 per ton for white powdered, Cornish makes, in Manchester. Business in sulphate of copper is restricted, with current quotations round £24 10s. per ton. Nitrate of lead is quiet but unchanged at about £41 per ton. Acetate of lead is steady at £45 per ton for white and £39 to £40 per ton for brown. Acetate of lime is offering at £14 10s. to £15 per ton for grey and £9 for brown, but the demand is not too active. Epsom salts are in small request though prices are maintained at £4 5s. to £4 10s. per ton; magnesium sulphate, pharmaceutical quality, is still quoted at about £6 per ton.

Acids and Tar Products

Oxalic acid is inactive, though at 3¾d. per lb. values are unchanged from last report. Acetic acid is in fair demand at round £39 per ton for 80 per cent. commercial and £67 for glacial. Citric acid meets with a quietly steady demand at 1s. 4½d. per lb. Tartaric acid is on offer at about 1s. per lb.

Coal-tar products are quiet generally. Pitch is still nominally quoted at about 41s. per ton, but demand is on a small scale. Naphthalenes are unchanged at about £14 per ton for refined and from £4 for crude qualities. Carbolic acid crystals are still quoted at 4½d. per lb. and crude at 1s. 6d. per gallon. Solvent naphtha and creosote oil are fairly steady at 1s. 5½d. and 6d. per gallon respectively.

Palm Sugar Production in India

A recent report issued by the Indian Department of Industries and Commerce contains the results of investigations into the manufacture of sugar from the juice of the palmyrah and date palms. The palms are stated to be a potential source of a very substantial increase in the raw sugar output, and the industry could be easily and economically developed in that it requires little capital and yields compare very favourably with sugar cane results.

World's Oil Production Prospects

Annual Meeting of the "Shell" Company

The Hon. Walter Samuel, chairman of the Shell Transport and Trading Co., Ltd., presided at the annual meeting held in London on Tuesday.

Reviewing the oil industry he said that the past year had been a remarkable one in that for the first year for some time the world's production had shown a slight decrease, actually about ½ per cent. Their own production, which in 1923 totalled 14,686,000 tons, fell to 13,388,000 in 1924. Practically the whole of this difference was attributable to the fall in their Mexican production, though their production in the United States of America dropped slightly. In all other fields they had slight increases, but in Venezuela the figures more than doubled, and had now passed the million tons per annum mark. Competition was very keen and had shifted from the race to produce oil to the means for bringing it to the consumer more economically. During 1924 rather a low price level had prevailed. There were several contributing factors. First, the population of Russia, instead of, as in pre-war years, being allowed access to its own oil supplies and thus using them up for its own requirements, had been deprived of them for the purpose of obtaining an exportable exchange commodity; the Chinese market had been affected by civil commotions; and Japan was still suffering from the after-effects of the earthquake of 1923.

The oil fields of the Dutch East Indies, Sarawak, and Egypt showed increased production. They were still dispossessed of Russian property, but Roumanian yields were satisfactory, although the Government was antagonistic to foreign enterprise. The United States interests were satisfactory, but Mexican production had been hampered by labour disputes, and they had hopes of oil from the Argentine drillings. Production had been more than doubled in Venezuela and the refinery was now capable of handling 7,000 tons a day.

Sir Waley Cohen's Overseas Visit

Sir R. Waley Cohen referred to his visit to Egypt, Aden, India, Ceylon, Australia, New Zealand, and America. He was impressed by the efficiency of the staffs everywhere and although competition was keener than ever they were holding their own. In India their arrangements with the Burmah Oil Co. had produced increased distribution efficiency at a minimum cost. In Australia Shell products were advancing rapidly in popularity and this country, like New Zealand, was only in its infancy as regards oil consumption. In America the organisation and sales were excellent and the company was still continuing its policy of costly search for new resources in order to maintain their world-wide reputation.

Institute of Chemistry Notes

Conference at York

Professor W. H. Roberts has been appointed Examiner in the Chemistry and Microscopy of Food and Drugs, and Mr. Lewis Eynon has been elected a Member of the Council of the Institute of Chemistry in his place. The election of Dr. Frankland Dent to the Council as representing members resident in the Dominions is also announced. Mr. Percy Calam has been appointed Hon. Secretary to the Huddersfield Section in place of Mr. Thomas Simmons, who has retired. The Council has appointed Dr. F. D. Chattaway and Mr. A. R. Smith to represent the Institute at the Industrial Chemistry Congress in Paris next September.

The Benevolent Fund Committee has formulated a scheme for the granting of annuities to members of the Institute.

At the invitation of the Ministry of Agriculture, the Council asked the Public Appointments Committee to consider the draft schedules to the proposed new Fertilisers and Feeding Stuffs Bill.

A Conference of Fellows and Associates of the Institute will be held at York on July 10 and 11 at the invitation of the North-East Coast Executive Committee. The President will open the conference in the Tempest Anderson Hall, when the subject for discussion will be "The regulations for the admission of Associates and Fellows of the Institute." At later meetings the subjects which will be discussed by the Conference include "The desirability and possibility of securing statutory registration of professional chemists," and "The promotion of further co-operation between the Institute and other chemical societies."

Company News

TARSLAG, LTD.—A dividend at the rate of 8 per cent. per annum has been declared on the preference shares for the six months ending June 30, 1925.

BRITISH PHOTOGRAPHIC INDUSTRIES.—The report for the year to April 30 last shows a profit of £155, against £110 for the previous year, making a credit balance to be carried forward of £958.

CYPRUS ASBESTOS CO.—After making provision for depreciation, operations for the year 1924 resulted in a loss of £10,417, which with the debit balance of £20,186 brought forward makes a debit of £30,604.

RAYON MANUFACTURING CO., LTD.—The prospectus was published on Monday of an issue at par of 300,000 7½ per cent. cumulative preference shares of £1 each and 300,000 deferred ordinary shares of 1s. each.

ROSARIO NITRATE CO., LTD.—The directors have decided to recommend the payment of a final dividend of 6 per cent., less income tax, in respect of the year ended December 31 last, making a total distribution for the year of 11 per cent.

SANTA RITA NITRATE CO.—The net profit for the past year amounted to £20,808. A final dividend of 12½ per cent., less tax, is recommended. The balance of £3,308 will be carried forward, increasing amount of credit of profit and loss to £15,912.

THE BLEACHERS' ASSOCIATION.—Payment of a dividend at the rate of 5½ per cent. on the preference shares for three months and 15 per cent. actual (making 20 per cent. for the year) on the ordinary shares was sanctioned at the annual meeting.

ATTOCK OIL CO.—A profit of £201,140 is reported for the year 1924, including £606 brought from 1923. The directors recommend a dividend for the year of 10 per cent., less tax at 4s. 6d. per £., payable on and after July 4. The sum of £51,140 is carried forward.

SHIP CANAL PORTLAND CEMENT CO.—The accounts for the year ended March 31 show a surplus of £50,946. A dividend of 5 per cent. is proposed on the ordinary shares, transferring £20,000 to depreciation account and £6,500 to preference shares dividend reserve fund, and carrying forward £9,167.

CHEMICAL AND METALLURGICAL CORPORATION, LTD.—At an extraordinary general meeting held on Wednesday, the special resolutions passed at the meetings held on June 9 for reduction of capital and creation of new ordinary shares of 2s. each (see THE CHEMICAL AGE, June 13) were confirmed unanimously.

BRITISH OIL AND CAKE MILLS, LTD.—Resolutions for the proposed arrangement with Lever Brothers (see THE CHEMICAL AGE, May 30 and June 20) were carried by the requisite majority at a meeting of shareholders on Monday, and will be submitted for confirmation as special resolutions at a meeting to be held on July 8.

SYNTHETIC AMMONIA AND NITRATES, LTD.—For the purpose of providing funds for additional buildings and plant, which will, it is stated, permit of a total output of 200 tons of pure ammonia per day, an issue of £2,000,000 5 per cent. guaranteed debenture stock, 1930-45, was announced on Monday, at the price of £98 per cent.

DE BEERS CONSOLIDATED MINES, LTD.—The directors have declared, in respect of the financial year ending June 30, 1925, a final dividend of 20 per cent., less Union dividend tax of 7½ per cent., to preference shareholders registered on that date. They have also declared a dividend of 20 per cent. (10s. per share), free of Union dividend tax, to deferred shareholders registered on June 30, 1925. Both dividends will be subject to British income tax at a rate to be agreed with the Inland Revenue authorities.

Tariff Changes

BELGIUM.—Molasses are provisionally subject to an export licence.

HUNGARY.—A Decree provides that the duties on benzene (Tariff No. 322 (*a*) 2), petroleum for lighting purposes (Tariff No. 322 (*b*)) and gas oil and mineral oil of all kinds (not elsewhere mentioned in the Tariff) for engines, axle oil and similar light oils and heating oil (Tariff No. 322 (*c*)), will continue to be levied until June 30, at the present rates. On and after July 1 these rates will be increased to 8 and 9 gold korona per 100 kilogrammes respectively—*i.e.*, to the rates prescribed by the Customs Tariff.

IRISH FREE STATE.—The Finance Bill embodies a proposal that Empire preference previously accorded to sugar, molasses, glucose and saccharin, be abolished.

JAMAICA.—Recent revisions impose upon motor spirit, including benzene, benzoline, gasolene, naphtha, and petrol spirits generally, a duty per gallon of 8d. and 6d. under the British Preferential Tariff.

NORWAY.—A fee is now leviable on margarine and margarine cheese imported.

New Chemical Trade Marks

Applications for Registration

This list has been specially compiled for us by Mr. H. T. P. Gee, Patent Agent, Staple House, 51 and 52, Chancery Lane, London, W.C.2, from whom further information may be obtained, and to whom we have arranged to refer any inquiries relating to Patents, Trade Marks and Designs.

Opposition to the Registration of the following Trade Marks can be lodged up to July 24, 1925.

"ZINCAZOL."

456,477. For chemical substances for use as accelerating agents in the vulcanisation of indiarubber. Ernest Smith, Paget Street Works, Paget Street, Collyhurst, Manchester, chemical manufacturer. February 20, 1925.

"STYGIAN."

458,395. For chemical substances used in manufactures, philosophical research, or photography and anti-corrosives, but not including size or substances of a like kind to size. G. H. B. Brotchie and Co., Ltd.; 32, Fenchurch Street, London, E.C.3, merchants and manufacturers. April 27, 1925.

Chemical Trade Inquiries

The following inquiries, abstracted from the "Board of Trade Journal," have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1. British firms may obtain the names and addresses of the inquirers by applying to the Department (quoting the reference number and country), except where otherwise stated.

CARBONATE OF AMMONIA.—An agent in Strasbourg is desirous of obtaining the representation of British firms for the above goods. (Reference No. 772.)

CHILE NITRATE, OIL SEEDS, ETC.—An agent in Copenhagen is desirous of securing the representation of British exporters of chile nitrate, Thomas meal, patent cattle foods and other feeding stuffs, as well as oil seeds and grain. (Reference No. 769.)

COTTON SEED OIL AND SOYA OIL.—A commission agent in Tangier desires to represent British manufacturers and exporters of the above goods. (Reference No. 792.)

WHITE LEAD, PAINTS AND VARNISHES.—A firm of manufacturers' agents in Cape Town desires to represent British manufacturers of white lead, ready mixed paints, varnishes, oxides, etc. (Reference No. 761.)

"Neocellon"

UNDER the title "The Application of Neocellon Solutions in the Electrical Industry," an interesting pamphlet has been issued by Neocellon, Ltd., of Garratt Lane, London, S.W.18, describing the uses of their substitute for linseed oil and other varnishes in the manufacture of electrical equipment. Among the advantages claimed for Neocellon is the fact that it produces flexible films of great mechanical strength, which are not acted on by spirit, dilute acids and alkalis, and oils, nor are they affected by heat. Neocellon solutions dry quickly in the air without the necessity of stoving, and insulation up to 30,000 volts may be obtained, according to the thickness of the coat applied. Three hundred different Neocellon solutions are manufactured, which have various properties, giving a range of films from those which are exceedingly hard to very flexible rubber-like coatings. A special solution which will adhere to oily surfaces and is extremely waterproof is also among those manufactured.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

MORDLE (F. DARE) AND CO., LTD., Nottingham, starch manufacturers. (M., 27/6/25.) Registered June 12th, £5,800 debentures (filed under section 93 (3) of the Companies (Consolidation) Act, 1908), present issue £5,200; general charge. *£9,000. April 30, 1924.

NEW SHEPLEY LINOLEUM CO., LTD., Horley Hill. (M., 27/6/25.) Registered June 15, mortgage and charge, to Midland Bank, Ltd., securing all moneys due or to become due to the bank; charged on Shepley Mills Linoleum Works, Shepley Road, Audenshaw; also general charge. *£5,000 debentures. £20,000 mortgage. August 20, 1924.

SYNTHETIC PRODUCTS CO., LTD, London, E.C. (M., 27/6/25.) Registered May 29, £800 debenture and £400 debenture, to Organic Products Syndicate, Ltd., and Ribbon Metals Syndicate, Ltd., both 50, City Road, E.C.; general charge. *£6,000. December 31, 1924.

THAMES BANK CHEMICAL WORKS, LTD., London, W.C. (M., 27/6/25.) Registered June 4, £2,000 debenture, to J. I. McConnel, 44, Mount Street, W.; general charge. *——. December 31, 1924.

Satisfaction

MORDLE (F. DARE) AND CO., LTD., Nottingham, starch manufacturers. (M.S., 27/6/25.) Satisfactions registered: June 12, £3,000 registered July 17, 1911; and £2,000 registered December 19, 1922.

Receiverships

PRODUCE AND CHEMICAL CO., LTD. (R., 27/6/25.) D. Lewis, C.A., of Kennans House, Crown Court, Cheapside, E.C., was appointed Receiver and Manager on June 11, 1925, under powers contained in debentures dated August 1, 1923, and February 16, 1925.

SOUTHDOWN CHEMICAL CO., LTD. (R., 27/6/25.) C. Milnes, of 56, Hamilton Square, Birkenhead, was appointed Receiver on June 10, 1925, under powers contained in mortgage dated December 21, 1922. H. P. Mounsey, of Lord Street, Liverpool, was appointed Receiver on June 9, under powers contained in a debenture dated February 20, 1925.

London Gazette, &c.

Winding Up Petition

BATH AND WEST OF ENGLAND SANITARY STEAM LAUNDRY DYEING AND CLEANING CO., Ltd. (W.U.P., 27/6/25.) A petition for winding up was presented on June 18 by H.M. Attorney-General, and is to be heard at the Royal Courts of Justice, Strand, London, on July 7.

Company Winding Up

COMET CHEMICAL CO., LTD., 81, Guilford Street, London, W.C.1. Meeting of creditors, June 29, 11.30 a.m., and of contributories, 12 noon, 33, Carey Street, Lincoln's Inn, London, W.C.2.

Company Winding Up Voluntarily

LAWFORD CHEMICAL WORKS, LTD. (C.W.U.V., 27/6/25.) R. F. W. Fincham, 3, Warwick Court, Gray's Inn, London, W.C., chartered accountant, appointed liquidator. June 3.

Notice of Dividend

STEVEN, George, manufacturing chemist, trading as G. STEVEN AND CO., 118, Chorlton Road, Old Trafford. First and final dividend, 4s. 3d. per £, payable June 25, Harry L. Price and Co., incorporated accountants, 47, Mosley Street, Manchester.

New Companies Registered

JOHN FOULGER AND SONS, LTD., 27, Clement's Lane, London, E.C.4. Paint and varnish manufacturers, oil, tallow, pitch, tar, paint and varnish merchants, etc. Nominal capital, £7,000 in £1 shares (2,000 5 per cent. cumulative preference and 5,000 ordinary).

OIL ALLIANCE, LTD. Importers, manufacturers, refiners and treaters and storers of and dealers in oil (mineral, vegetable or animal), etc. Nominal capital, £100,000 in 95,000 preference shares of £1 and 100,000 ordinary shares of 1s. each. Solicitors: Bullen, Debenham and Co., 52-3, Cheapside, London.

PATENT RETORTS, LTD, 40-43, Norfolk Street, London, W.C. To acquire patents related to or connected with the distillation or carbonisation of coal or other carbonaceous substances, etc. Nominal capital, £2,250 in £1 shares.

TARBO CHEMICAL CO., LTD. Wholesale and retail manufacturers of and dealers in oils, greases, soaps, creosote, tar, chemicals, acids, disinfectants, alkalies, soda, resin, vitriol, powders, potash, etc. Nominal capital, £2,000 in £1 shares. Solicitors: Russell and Russell, 11, Wood Street, Bolton,

Latest Government Contracts

THE following contracts have recently been placed by the various Government Departments:—

Admiralty

CIVIL ENGINEER-IN-CHIEF'S DEPARTMENT.—Macadam Topping: The Tarmac (South Wales), Ltd., Ettingshall, Wolverhampton. Cement: T. Beynon, Ltd., London, E.C.

CONTRACT AND PURCHASE DEPARTMENT.—Diethyl-diphenyl-urea: L. B. Holliday and Co., Ltd., Huddersfield. Dryers, Ground: Blundell Spence and Co., Ltd., Hull; John Hare and Co., Bristol. Oils, Linseed: Wm. Graham and Co., London, S.E.; Younghusband, Barnes and Co., London, S.E.; Dixon and Cardus, Ltd., Southampton; F. F. Fox and Co., Bristol; Smith Bros. and Co., London, E. Red Lead: Walkers, Parker and Co., Ltd., Chester. Varnishes, etc.: Blundell, Spence and Co., Ltd., Hull; Robert Ingham Clark and Co., Ltd., London, E.; Gross, Sherwood and Heald, Ltd., Barking; Naylor Bros. (London), Ltd., Slough; Charles Orme and Co., Ltd., London, S.E.; Paripan, Ltd., Egham; C. W. Waters, Ltd., London, E.C.; L. G. Wilkinson, Ltd., London, E.C.; S. Wills and Co., Ltd., Bristol.

War Office

Aluminium: British Aluminium Co., Ltd., Warrington.

Air Ministry

Extinguishers, Fire: General Fire Appliance Co., London, E.C. Floats, Duralumin: Short Bros., Ltd., Rochester. Oxygen, Gaseous: British Oxygen Co., Ltd., London, S.E. Paints, Aircraft: L. Berger and Sons, Ltd., London, E.

Post Office

Desiccators and Pumps: Sidney Smith and Sons (Nottingham), Ltd., Nottingham.

H.M. Office of Works

Asphalt: The Ragusa Asphalt Paving Co., Ltd., London, W. Fire Extincteurs, Washers and Charges: Mather and Platt, Ltd., London, S.W. Soap (Soft): Peter Lunt and Co., Liverpool.

Crown Agents for the Colonies

Asbestos Slates: The British Fibrocement Works, Ltd., London, W.C. Cement: Cement Marketing Co., London, S.W.; T. Beynon and Co., Ltd., London, E.C. Coal Tar: Gas Light and Coke Co., London, E.C. Disinfectant: Sanitas Co., Ltd., London, E. Disinfectors: The Thresh Disinfector Co., London, S.W. Laboratory Apparatus: Baird and Tatlock, Ltd., London, E.C. Machine, Grinding: The Churchill Machine Tool Co., Ltd., Broadheath, Altrincham, Manchester. Machines, Disinfecting and Gassing: The Clayton Fire Extg. and Disfg. Co., Ltd., London, W.C. Machines, Tar Spraying: The Phœnix Eng. Co., Ltd., Chard. Novarsenobillon: May and Baker, Ltd., London, S.W. Oil: Vacuum Oil Co., Ltd., London, S.W.; J. Light and Sons, Ltd., Liverpool. Paint: R. Kearsley and Co., Ltd., Ripon. Quinine: Howards and Sons, Ilford, Essex; Burroughs, Wellcome and Co., London, E.C. Sheets, Asbestos, etc.: Bell's Poilite and Everite Co., Ltd., London, S.E. Sheets, Corr. Asbestos Cement Roofing: The Asbestos Manufacturing Co., Ltd., London, S.W. Sulfarsenol: Wilcox, Jozeau and Co., London, W.C.

Metallurgical Section

Published in the first issue of "The Chemical Age" each month

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NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, 8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

Some Properties and Uses of Silver

By N. F. Budgen, Ph.D., M.Sc.

The writer describes the various silver ores and the modern methods of extraction. In addition, he discusses the compounds and alloys of industrial importance and the uses to which they may be put.

SILVER occurs both native and as sulphide in silver glance (Ag_2S), as chloride in horn silver (Ag Cl). Large quantities are obtained from galena, the ore of lead, which contains traces of this metal. All the silver present in the lead ore will be contained in the lead produced from it and may be extracted by various well-known processes.

The oldest method of obtaining silver consisted in fusing the ore with lead, when the latter metal dissolved out the silver, which was recovered by "cupellation." In this process advantage is taken of the readiness of lead to oxidise with the formation of litharge at high temperatures while the silver remains unoxidised. The process is usually carried out in a special type of reverberatory furnace, having an almost ellipitical hearth, suitably hollowed out, and lined with bone ash. A strong current of air is forced over the molten alloy and the lead slowly oxidised, the melted oxide being driven out of the cupel by the blast. Since in the last stages the litharge would carry much silver with it, the usual procedure is to stop the first cupellation before loss of the precious metal occurs, and to subject the richer alloy to a further cupellation, reserving the litharge so produced for future reduction and recovery of the silver it contains. There must be at least 8 oz. of silver per ton of lead if the cupellation is to be economically carried out. An ancient, but still used process, for extracting silver from its ores, is by amalgamation with mercury, the latter being afterwards distilled off.

Some General Uses and Properties

The ancient Chinese and the later Egyptians, Greeks, and Romans made ornaments and utensils of silver, and used polished silver sheets as mirrors. Silver is rarely used in the pure state, as it is too soft; and is, therefore, generally alloyed with other metals, chiefly copper. English standard silver is an alloy containing 7·5 parts of copper to 92·5 of silver.

Silver is the whitest of all metals and admits of the highest polish. It is the best conductor of heat and electricity. It is very ductile, and may be drawn into wire twenty times finer than the finest human hair by pulling through a perforated diamond. It is so extremely malleable that it can be beaten out into leaves that transmit a bluish light. The thinnest perfect unbroken plate known to have been beaten is one hundred and thirty-seven thousandths of an inch in thickness. Silver melts at 962° C., and possesses the remarkable property of absorbing many times its own volume of oxygen from the air, while in the molten state, giving off the gas again upon solidification. When a mass of molten silver is allowed to cool, the film of solid metal which is formed upon its surface is burst in several places by the escaping oxygen, forming peculiar craters and cones. This phenomenon is called "spitting," and may cause a loss of metal.

Silver is used extensively for coating other metals by electrodeposition; the object to be plated is placed in a bath consisting of silver chloride dissolved in potassium cyanide solution. The article to be plated is, of course, connected to the negative pole of a source of electric power and forms the cathode; the positive pole being connected with a platinum plate or silver anode and immersed in the bath near the object to be plated. Silver is employed for silvering mirrors and reflectors. To accomplish this, the perfectly cleaned glass is laid upon a warmed table covered with cloth or baize and upon the surface of the glass a solution containing silver nitrate, a little ammonia, sodium hydroxide, and grape sugar, is poured. In a very few minutes the warmth acting upon the solution deposits pure silver upon the glass plate in a coherent form; the excess liquid is poured off (for extraction of the silver it still contains) and the silvered plate washed and dried; a coating of protective paint is then given after a previous suitable gentle polishing.

Silver is adopted in many countries as one of the metals for coinage, the standard varying according to the particular law of the country concerned. The pre-war standard of the United States and of France was 10 per cent. of tin and copper to 90 per cent. of pure silver. Silver bullion is the term applied to silver in the mass, *i.e.*, in ingots or bars—as distinct from coin or plate. When it contains gold it is called "doré" silver, and is then bought by gold and silver refiners. "Refined" silver is nearly pure and practically free from gold. It usually contains 997·5 to 998·5 or occasionally 999·0 parts of silver in 1,000 parts, when it is said to be 997·5, 998·5, or 999·0 fine. Fine silver is chemically pure. In London the price is quoted per ounce Troy in terms of standard silver (925 silver per 1,000), but in New York the price quoted is for fine, *i.e.*, pure silver.

Chemical Compounds of Industrial Importance.

Oxides.—Silver does not combine readily with oxygen, and on this account is useful for coating other metals and for coinage, the tarnishing of silver being due to the presence of sulphur compounds in the air, which coat the silver with a thin film of sulphide. Two oxides of silver are known, both very unstable and therefore powerful oxidising agents. The monoxide Ag_2O is prepared by precipitating a solution of silver nitrate with alkaline hydroxides; a brown earthy powder is obtained, excessively soluble in ammonia, and this solution evaporated at a gentle heat yields crystals, probably of the composition ($Ag\ NH_2$), which are most violently explosive at the slightest touch. Fulminating silver is made by heating nitrate of silver with nitric acid and alcohol. This forms small, acicular, poisonous crystals, white in colour, which are the fulminate. These crystals are very dangerous, for they explode with great violence often on the mere touch by a glass rod under water. The fulminate is used in the manufacture of bombs, percussion caps, detonators, etc. Silver dioxide (Ag_2O_2) is a brown powder produced by the action of ozone on silver.

Nitrate.—A well-known compound of silver is the nitrate, which may be obtained in two forms, crystallised and fused. The crystallised form is interesting, because, though it is blackened by light, and by contact with all organic substances, should the solution be made with distilled water, light will not affect it, so long as no organic matter is present, but the instant the least trace of organic matter is admitted, light commences to darken it, and the mere lifting of the stopper of the bottle containing it, on and off quickly, is usually sufficient for the admission of the organic matter necessary to commence its changes of colour. The second form of silver nitrate, the fused variety, well-known as lunar caustic, is used extensively on account of the cauterizing action upon animal tissue.

Halogen Compounds

Silver combines with the halogens, chlorine, bromine, and iodine, forming salts having the composition respectively represented by Ag Cl, Ag Br, and Ag I. These salts are easily prepared from silver nitrate by precipitation with the chloride, bromide, or iodide of potassium. The three halogen compounds show, in a marked degree, the action of light on silver salts, namely, their unstability under the action of white light. Certain parts of the spectrum, the blue end especially, have the power to decompose them, with the formation of subsalts, and for this reason they have been employed most successfully in the processes of photography.

As the metal is not attacked by caustic alkalis, a safe method of removing tarnish from silver ware, is to immerse it in ammonia solution, which will rapidly remove the black stains and do no injury. Although silver is unaffected by oxygen in the air at ordinary temperatures, it has a strong affinity for sulphur. For example, if a piece of rubber is kept in the same pocket with a silver coin, or other article, the surface will be blackened by the sulphur present in the rubber. Silver dissolves readily in cold nitric acid but less readily in cold sulphuric acid, though it will dissolve easily if the latter is warm or hot.

Alloys of Industrial Importance

Silver and Copper.—Some of these alloys have already been mentioned. Silver can be alloyed with copper in all proportions but some of the alloys, except the one of eutectic composition, are not homogeneous throughout. Levol's alloy so-called, is the eutectic and contains 71·9 per cent. of silver and is homogeneous throughout no matter what the rate of cooling from the molten state. This alloy has been used for coinage in the Dutch Indies. On account of the tendency of silver copper alloys not of eutectic composition, to segregation and inhomogenity, it is important in sampling them to take samples from the molten metal and not from solidified ingots. Bullion containing less than 25 parts of copper in 1,000 may, however, be sampled by drillings from the ingot, as solid solutions form over this range.

Silver and Cadmium.—These alloys are softer, whiter and more malleable than silver-copper alloys. The alloy containing 75 parts of cadmium in 1,000 is perfectly homogeneous and has been suggested as a suitable alloy for standard trial plates.

Silver and Bismuth.—Silver alloys with bismuth in all proportions, and the latter metal may be separated from it by cupellation, but there is a tendency for small quantities to remain, and these are sufficient to produce brittleness. These alloys must, on account of inhomogeneity, be sampled by " dips " and not from cuttings.

Silver and Zinc.—These alloys have been suggested as suitable for coinage on account of their resistance to tarnishing and their good mechanical properties. Peligot found that with 13 to 20 per cent. of zinc, the alloys are moderately malleable, and an alloy containing 20 per cent. of zinc is not discoloured by alkaline sulphides. Zinc has a strong affinity for silver and will remove it from lead, at a temperature slightly above the melting point, and it is upon this process that the method of Parkes for desilverisation of argentiferous lead, depends.

Silver and Lead.—Lead has a stronger affinity for silver than copper, so that when an alloy of silver and copper with an excess of lead is heated to a temperature between the melting points of lead and copper, the lead liquates and carries the silver with it. The ancient liquation process now abandoned, except in Japan, was based on this phenomenon. Silver lead alloys are inhomogeneous when solid, so that dip samples and not cuttings, must be taken for analysis.

The process of cupellation for separating silver from lead, has been described already.

Silver and Mercury.—These metals form one definite amalgam consisting of 30·4 per cent. silver and 69·6 per cent. mercury, agreeing with the formula $Ag_2 Hg_3$. The amalgam first formed on silver in contact with mercury does not readily dissolve in the surrounding mercury, but rather tends to hinder its further action. For this reason it is very important in the amalgamation of silver ores for extraction of the silver, to grind very thoroughly, so as to remove this layer and lay bare fresh surfaces of silver to the action of the mercury.

Corrosion of Iron by Water

By A. Pickles, M.Sc.(Lond.)

THERE was recently brought to my notice an example of corrosion inside the water cooling jacket of a large gas engine. The problem in its solution brought out many interesting and important facts about the corrosion of metals in contact with water.

In this particular case the cooling water was used over and over again during a whole week and to assist cooling the circuit of the water was interrupted by splash boards well open to the air. At the same time a current of air was drawn through the water by a fan revolving at high speed. The in-draught of air was so great that considerable quantities of the exhaust gases of the engine were also drawn into the water, with the obvious result that the water became acid—sulphurous acid being detected—and corrosion very rapid. The pipe supplying the cool air was then removed a considerable distance away, but though a considerable improvement was observed corrosion on the water jacket still continued.

The cooling water used was taken from the town mains, the supply being from a peaty district. A small amount of magnesium chloride was present in the water. In hot water, and to a greater extent in boiling water, magnesium chloride breaks down into magnesium oxide and hydrochloric acid. This change would take place chiefly near the hottest parts of the engine, and had not the casing been made of special steel the injury done would have been much more serious than was the case.

But there is another factor to be considered. Carbon di-oxide, especially if oxygen is also present, will bring about corrosion of almost any kind of metal. The effect of this combination on iron may easily be seen by placing iron nails in water free from carbon di-oxide but oxygen present and more nails in water containing carbon di-oxide as well. Rusting is obviously more rapid. It is probable that the carbon di-oxide acts almost as a carrier for the oxygen, forming a carbonate of iron which breaks down into oxide of iron, which readily becomes the oxide Fe_2O_3, carbon di-oxide being released for further action. Movement of water will bring a constant supply of oxygen and carbon di-oxide and erosion effects might also appear. Even though pure air is used for cooling the water, if large volumes are used considerable amounts of CO_2 must, of necessity, pass through the water, since air contains CO_2 to the extent of about 0·03 per cent.

Another factor to be considered is the homogeneity of the metal used. In the case of iron vessels perfect uniformity is impossible, some places being harder than others. Some engineers maintain that corrosion is greatest at the hard parts and others at the soft parts, but there is no doubt that differences in structure do affect the action. This point brings us to the electro-chemical effects which are bound to be present if particles differing in their nature are in contact with each other, and both in an acid medium or in a solution containing salts, no matter how small the quantity. In the case of the water jacket mentioned above this action had probably taken place, for much of the iron had gone in some parts, leaving a surface which could be removed by a knife. In water mains corrosion may take place through the action of stray electric currents. The remedy in such cases is to earth the pipe at intervals, using iron plugs, each plug resting in a pocket of carbon (broken coke, or better, gas carbon). Water pipes also corrode most on the upper surface, since this surface is wet, yet not covered with water, since pipes carrying water always have more or less air space between the pipe and the water surface. This upper surface is, therefore, subjected to the action of oxygen, carbon di-oxide and moisture —ideal conditions for corrosion.

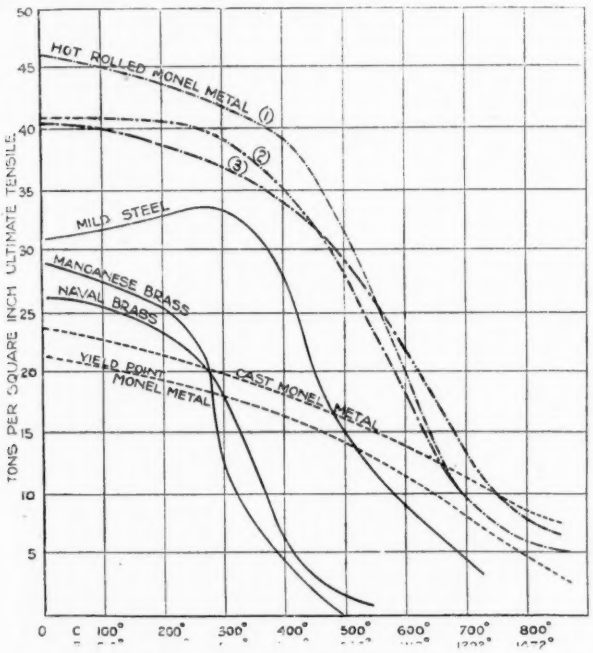
The nature of the soil in which the pipes are laid is also a point worthy of note. For example, much lime in a soil will soon show its effect on leaden pipes, while an acid soil will have an effect on cast iron pipes.

Prevention of corrosion in pipes, cisterns or boilers is, of course, a very important problem. Almost a complete remedy for the corrosion first described was found by adding a little caustic soda to the cooling water. Sufficient was added to preserve slight alkalinity. Possibly this might prove a remedy in other cases.

Properties and Uses of Monel Metal

By Hartland Seymour

MONEL metal, which has gained considerable favour in the United States for resisting most forms of corrosion, consists of roughly 67 per cent. nickel, 28 per cent. copper and 5 per cent. of other metals. It contains no tin, zinc or antimony, and is made direct from the ore without separating the constituent metals. In appearance it resembles nickel, taking the same high finish, but it has a somewhat softer and more silvery lustre. It has the strength, toughness and ductility of steel, and resists corrosion better than copper, gunmetal and bronze. It machines easily, and can be rolled, drawn, cast, forged, soldered and welded. The hot rolled metal has a tensile strength of 30 to 42 tons per sq. in., according to size and treatment, while ordinary cast monel metal has a tensile strength of 19 to 25 tons per sq. in., according to the character of the casting.



One of the most valuable properties of this metal is the tensile strength it possesses when subject to high temperatures. For example, at a temperature of 750 deg. F., at which brass or bronze ordinarily has a strength of about 5 tons, monel forged rod has a strength of over 35 tons. The curves shown in Fig. 1 give strengths at various temperatures, as compared with those of other metals; the curves 1 and 2 being the result of experiments carried out at the works of Messrs. G. and J. Weir at Glasgow, while curve 3 is from tests made by the physical laboratory of the International Nickel Company of U.S.A.

In addition to the strengths shown in Fig. 1, some other properties of monel are shown below:

Melting point	1,360° C.
Pouring temperature for castings	1,500° C.
Specific gravity	8·82.
Weight per c. in.	0·323 lb.
Shrinkage allowance for castings.	0·25 in. per ft.
Co-efficient of expansion	0·0000137 per 1° C.
Electrical resistivity	48 microhms per c. cm.
Heat conductivity	1/15th that of copper.
Brinell, cast	120 to 140.
Brinell, hot rolled rods and sheets	150 to 190.
Brinell, cold drawn bar	200 to 217.
Izod test	107 to 115 ft. lb. unbroken.

Monel metal in the rolled condition is magnetic at room temperatures. As in the case of pure nickel, monel becomes non-magnetic when heated to a comparatively low temperature, from about 100 deg. to 150 deg. C. This change is reversible, and on cooling the magnetic property is restored. Permeability and hysteresis tests show that under a magnetising force H of 100 c.g.s. units, the number of lines per sq. cm. B is 2,460. Under the same conditions B for steel is about 18,000. The remanence is 990 and the coercive force 1.1.

Monel metal has been used very successfully for resisting the action of superheated steam, and valves and seats fitted five years ago and subject to a temperature of 750 deg. F. are still in good condition. It has proved also of considerable service in the chemical and other industries where resistance to corrosion is essential. It will not, however, resist the action of all acids, as is shown on the chart.

MONEL METAL

will resist —
- Aluminium sulphate,
- Alkaline soap.
- Ammonia.
- Benzoic acid.
- Boric acid.
- Butyric acid.
- Calcium sulphate.
- Calcium chloride.
- Carbolic acid.
- Chlorine.
- Crystallisation of alum.
- Formic acid.
- Hydrocyanic acid.
- Hydrogen.
- Hydrofluoric acid.
- Lactic acid.
- Lime.
- Malic acid.
- Oleic acid.
- Oxygen.
- Palmitic acid.
- Phosphoric acid (cold–weak).
- Picric acid (cold).
- Potassium hydroxide.
- Salicylic acid.
- Sodium hydroxide.
- Sodium hyposulphite.
- Stearic acid.
- Sulphur dioxide.
- Tartaric acid.
- Water, fresh.
- Water, salt.
- Atmosphere.
- Metallic mercury.
- Heat (oxidation) not above 700° C.
- Steam, superheated.
- Steam, wet.

will not resist —
- Chromic acid.
- Copper sulphate.
- Mercuric chloride.
- Nitric acid.
- Perchloric acid.
- Phosphoric acid (hot).
- Picric acid (hot).
- Sulphurous acid.
- Saturated ammonium nitrate solution.

action varies with conditions —
- Acetic acid.
- Citric acid.
- Hydrochloric acid.
- Muriatic acid.
- Sulphuric acid.
- Tannic acid.
- Zinc salt.
- Gases of combustion.

The James Douglas Medal

AWARD of the James Douglas gold medal to Mr. William H. Bassett, metallurgist to the American Brass Company, Waterbury, Conn., is announced by the American Institute of Mining and Metallurgical Engineers. The medal, commemorating Dr. James Douglas, twice president of the Institute, is bestowed annually for distinguished achievement in non-ferrous metallurgy. It was established in 1922 by anonymous donors. The award, made by the James Douglas Medal Committee, was unanimous. Mr. Bassett is one of the most widely known metallurgists in the United States. He is a director of the Institute, of which he has been a member since 1892.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Corrosion-Resisting Steels

WITH reference to some notes on corrosion-resisting steels of high strength, published in "Metallurgical Topics" on October 4, Thos. Firth and Sons, Ltd., Sheffield, write that they were particularly interested in reading this account and point out that the second steel mentioned—namely, austenitic carbon steel—is a material which they are at present manufacturing under patent rights in this country. It is marketed under the name "Firth Staybrite," and the makers claim that it has a wonderful malleability and is very suitable for press work.

Physics in Industry

THE Institute of Physics continues to supply, with credit to itself and advantage to the cause of science at large, opportunities for filling up the very real *hiatus* between applied chemistry and physics, as will be seen by the second volume of *Lectures* it has just published. These include an address on "The Applications of Physics to the Ceramic Industries," by Dr. J. W. Mellor; "The Physicist in the Textile Industries," by Dr. A. E. Oxley; and "The Physicist in Metallurgy," by Professor Desch. All three lectures are suggestive, even if they deal with their respective subjects on generalised and somewhat obvious lines. Dr. Mellor deals incidentally with firebricks and refractory clays, the physics and chemistry of which are becoming of increasing importance to the metallurgist, and indulges in a sly dig at the "hill top" attitude of those who profess such admiration of science as a pure end in itself and are inclined to belittle its industrial applications. As he rightly points out, "many types of research in industrial work are more difficult . . . than the ordinary type of research." There is, he says, less control of conditions.

Dr. Desch says "At the present day a sound knowledge of physics is as essential to a trained metallurgist as a knowledge of chemistry." This puts the matter in a nutshell, and it is well that our University teachers should lay such precepts to heart, and give practical application to them by seeing that the proper balance is attained in graduate courses. There is a certain amount of gain in stock-taking of this description. Perhaps the most serious aspect of the problem is the one we hear least about—from the professors. It is this: Is the typical "examination," as conducted, really the best means for ascertaining the extent to which a student has acquired, *and assimilated*, a really competent and well-proportioned grasp of his subjects? There is always the risk of overloading, with the result that what has been hastily crammed becomes as hastily forgotten. There is a *technique* of "passing exams." which often defeats their ostensible purpose.

Commercial Data an Asset for the Metallurgist

A MAN may be a very good chemist, physicist or metallurgist, or may have a working knowledge of all three branches of science and competent engineering knowledge and experience as well, and yet be a mighty poor business man. It is one thing to know how to make iron or steel, and quite another thing to know how to sell—or, for the matter of that, how to buy. There is almost as vast a technique in knowing market conditions and the commercial details of stocking, merchanting, and dealing as there is in "straight" metallurgy. Such things are usually acquired in "office work" as distinct from works practice, and are usually not to be obtained from books, for the simple reason that books seldom supply the necessary information. The ambitious chemist or metallurgist must acquire this knowledge somehow if he is to rise to general managership or the board, and, conversely, the merchant and shipper is much more capable of achieving success in business if he has some knowledge of the technique of production and of the conditions under which his staple is produced in practice. An admirable book which supplies just the right amount of detail in regard to both categories has just been published by Mr. H. J. Skelton, whose *Economics of Iron and Steel* is a work of quite exceptional scope and merit. Herein is revealed the whole art and mystery of the business of the iron and steel merchant, and every technical man will derive distinct benefit by making himself acquainted with what Mr. Skelton has to tell him. The book is by way of being rather wonderful, and it may safely be said that no other industry has, as yet, been supplied with so useful a compendium. Just what can, and what cannot, be done, economically speaking, in regard to the rolling of sections, cutting to size, trimming and straightening, is clearly set forth, and valuable guidance is imparted respecting the special qualities of material required for specific purposes, information rarely obtainable in the average "text book." Mr. Skelton deserves the warmest thanks for having placed at the disposition of iron and steel men generally the wealth of his many years' experience, and his unique book will be greatly valued by all concerned, immediately or remotely, with the iron and steel industry.

Comparative Steel Practice

WHAT Mr. Fred Clements has so ably done in regard to British steel furnace practice has, to a lesser extent, been done by M. A. de Grey, who has instituted a comparison between typical good American and French open hearth steel practice. In American practice he finds air and water cooling developed to an extent that is economically unsound, as it both increases the heat losses by radiation and diminishes the furnace yield. On the other hand the utilisation of waste heat for boilers is carried to a greater extent in America than in France, where the spent gases are at a far lower temperature than in American practice. Other points of difference, such as furnace dimensions, length and angle of ports, etc., are discussed. Broadly speaking, American furnaces make fewer casts than French furnaces, the ratio per 24-hour working being 2 : 3. The coal consumption per ton of steel is likewise higher in American furnaces than in the best modern French practice, being 260 to 280 kilogrammes as against 210 to 230 tons. This is claimed as indicative of the marked superiority of French furnace design and practice as against American design and methods of working, and, if rightly stated, would appear fully to justify the claim.

The Oxidation of Zinc Vapour

THE problem of the efficient condensation of zinc vapour to liquid zinc, though it has always been of great importance in zinc metallurgy, has not been satisfactorily solved. Ordinarily a large proportion of the volatilised zinc does not condense to liquid, but is obtained as the fine dust called blue powder. Only with difficulty and by taking special precautions can this powder be caused to melt and to coalesce into liquid; consequently a second distillation and condensation usually is necessary to obtain the zinc in liquid form. In ordinary retort melting plant 20 to 25 per cent. of the retorts are required continuously for the redistillation of blue powder, and from 25 to 35 per cent. of the total zinc produced is obtained from these retorts. In other words, in the primary distillation of zinc from its ores about one-third of the zinc vapour condenses as blue powder and only about two-thirds as liquid zinc.

All attempts at smelting zinc ores in a blast furnace have failed, because the zinc has always been obtained as a mixture of zinc oxide and blue powder. Most of the electrothermic processes that have been tried have also encountered this difficulty, and but few of them have succeeded in obtaining high yields of liquid zinc from the primary distillation. The electric zinc-smelting works in Scandinavia, which are the only ones at present using an electrothermic process on a commercial scale, have abandoned the effort to obtain liquid zinc from the first smelting operation. Formerly they redistilled the blue powder produced from the primary distillation of the ore, but in recent years have found that the powder can be melted by heating it to a temperature above the melting point and subjecting it to rubbing action. American metallurgists who have experimented with electrothermic processes have progressed somewhat further, and a few have succeeded in obtaining satisfactory yields of liquid zinc in one operation.

Experimental Work in the United States

In spite of these exceptions, preventing the formation of blue powder is still a troublesome problem in all pyrometallurgical processes for treating zinc ores, and a complete knowledge concerning the various causes of blue-powder formation would be of much value to zinc metallurgists. Because of the important effect of carbon dioxide on the condensation of zinc vapour in the metallurgical treatment of zinc ores, experiments were made by the U.S.A. Bureau of Mines to determine the concentration of carbon dioxide necessary to oxidise zinc vapour at various temperatures. Although the preliminary experiments failed to give the quantitative information desired, they proved that the required concentration of carbon dioxide increased with rising temperature. It was found that zinc oxide was reduced at 750° C. by carbon monoxide even when carbon dioxide was present in large proportions, but that partial reoxidation took place in the cooler part of the reaction tube. The weight of zinc oxide reduced in a given time decreased with increasing ratios of carbon dioxide, and when 90 per cent. of carbon dioxide was present the reduction and reoxidation was manifest only by a transfer of zinc oxide from the hot to the cooler part of the tube.

In the prelimianry experiments with zinc it was found that oxidation took place in the cooler parts of the reaction tube, even when the concentration of carbon dioxide was not enough to oxidise zinc in the hot part of the tube. It was furthermore found that all carbon dioxide was converted to carbon monoxide by reaction with zinc at some temperature between 750° C. and room temperature, if enough time were allowed for the completion of the reaction. With the knowledge gained from these preliminary experiments, a final series of experiments was planned, from which the desired quantitative data were obtained. These data were plotted, and a curve drawn from which may be found the minimum concentration of carbon dioxide at any given temperature that will have an oxidising effect on zinc vapour under the conditions of zinc condensation in metallurgical practice. It has also been demonstrated that the oxidation of zinc vapour by carbon monoxide is theoretically possible, though this oxidation is ordinarily of little practical importance.

The detailed results of the work conducted are given in a paper (Technical Paper No. 336) compiled by Mr. B. M. O'Harra, which may be obtained at a price of 5 cents from the U.S. Government Printing Office at Washington.

The Future of Cast Iron

Mr. J. G. Pearce, Director of Research, of the British Cast Iron Research Association, recently addressed the members of the Newcastle and District Branch of the Institute of British Foundrymen on "The Future Improvement of Cast Iron." The problem, he said, of the improvement of cast iron to-day largely depended on the extent to which those channels could be made to work in co-operation. There was no denying that chemistry and physics had improved their knowledge of the structure of metals, and that knowledge must be used if they were to continue to develop the industry and improve the product. Cast iron, which was sometimes looked upon as the metallurgical Cinderella, was about the oldest constructional material known, and owing to its method of production, it had always been the cheapest. But it had not, up to recently, had the specialist metallurgical study in this country that had been given to the steel industry. The result was that certain other industries had come into the cast iron field, and had displaced it for certain applications. At the present time, cast iron was not uniform enough in quality, and not homogeneous enough for the engineer. It was necessary, therefore, that cast iron should be studied a great deal more so that it could be used up to its limits, so far as cheapness and inherent qualities would permit. It was remarked in the discussion that the average foundryman knew little about it. An engineer was told all about steel, and naturally, when he wanted material for a certain service, he used that about which all the information was easily obtained.

Wear of Railway Rails

Our Paris correspondent states that an analysis of the conclusions of M. Frémont, who is the author of a remarkable book on the wear and defects of rails, has been presented by M. Lecornu to the French Academy of Science. The author, in examining the classical recourse to very hard metal as a means of avoiding wear, shows that this remedy involves another drawback. When the wheels pass, and above all when they "skate," the metal tempers, and a superficial layer of different cohesion is formed. M. Frémont describes with minute detail the principal faults in rails, and his work constitutes, in M. Lecornu's words, a pathological museum of the railway track. He recommends the use of a metal exempt from all internal contamination and with a traction resistance not exceeding 60 kilogrammes (28 lb.). In other words, the manufacture of the metal should be carried out with special care and be the object of continuous supervision.

Metallurgical Plant Accidents

Accidents occurring at metallurgical plants in the United States in 1923 resulted in the death of 58 men and in injury to 8,476 others, according to statistics compiled by the U.S.A. Bureau of Mines. The figures constitute a fatality rate of 0·96 and an injury rate of 141 per thousand full-time (300 day) workers. For 1922 the corresponding rates were 0·98 and 145 respectively.

Reports received by the Bureau of Mines from companies operating ore-dressing plants and smelters in 1923 indicated a continuance of the upward trend, begun in 1922, from the low record of 1921, in volume of work done by the industry. At ore-dressing plants the number of man-shifts of work reported was 92 per cent. above 1921 and 40 per cent. above 1922; it was only 8 per cent. below 1920, the most recent "normal" year. The reports for smelting plants showed an increase of 88 per cent. in the number of shifts worked as compared with 1921, and an increase of 28 per cent. as compared with 1922; the number was within 12 per cent. of the number of shifts worked in 1920. The average working time at ore-dressing plants was 300 days per man; at smelters, 357 days; the former figure has not been exceeded since the war year 1918, when the average operating time was 310 days per man; the latter figure for smelting plants is the highest on record. The nearest approach to the record for smelters in 1923 was that for 1913, when 355 work days per man was recorded. The increase in volume of work was general throughout the country, and was shared by nearly all States.

The reports showed a total of 54,418 men employed during 1923 at ore-dressing plants, smelters, and auxiliary works; the men worked 18,047,774 days, an average of 332 days per man. The number of shifts worked was 4,245,456 in excess of the number reported for 1922.

The accident rates in the metallurgical industries for 1923 are classified as follows: For mills, the rates per thousand full-time workers were 1·55 killed and 168 injured; for smelters 0·64 killed and 131 injured; for auxiliary work, 0·94 killed and 132 injured.

Value of Manganese in Steel

In view of the frequent suggestions for the more extensive use of manganese-carbon steels instead of pure carbon steels, especially when heat-treated steel is required, the Woolwich Research Department's Report (No. 61) is of interest. This report gives an account of an investigation on the properties of medium carbon steel with high manganese content, by Mr. J. A. Jones. It appears from his results that after oil-hardening at 850° C. and tempering at 650° C., all the mechanical properties of a 0·4 per cent. carbon steel are improved by the presence of about 2 per cent. of manganese. The improvement is still maintained at 3 per cent., but the additional manganese shows no advantage and may introduce difficulties in forging. Steels with high manganese content are extremely liable to show temperature brittleness when slow rates of cooling after tempering are employed, but this may be avoided by suitable heat treatment. If good impact figures are to be secured, the cooling from the tempering temperature must never be slower than in air. The author finds that the critical points Ac_1 and A_1 are lowered by the increasing amounts of manganese. In this he confirms the work of previous investigators. Ac_3 and Ar_3 are also lowered, and with sufficient manganese merge into Ac_1 and Ar_1 respectively. The presence of manganese tends to prevent the separation of ferrite and pearlite on cooling. For purposes for which it is desired to replace carbon steel forgings by steels of greater strength, the author suggests carbon from 0·35 to 0·40 per cent., manganese from 1·8 to 2·2 per cent., oil-hardened from 800° to 850°, tempering from 610° to 650° C., and cooling in air, oil or water.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

As far as the iron and steel trade is concerned, the year 1924 can be left behind without regret. It adds another year—and let us hope the last—to the most trying period that the industry has experienced. It has been a year of unfulfilled expectations. The commencement was rather promising, with a general spirit of optimism, but this was of short duration and soon gave place to the old feeling of depression, which has prevailed for the greater part of the year. So the industry has struggled along, waiting for the revival which is bound to come, but which is so long delayed.

Two Achievements

Nevertheless the year has been marked by two achievements which cannot fail to have a favourable influence on trade. These are the European settlement on the Dawes Report, and at home the establishment of a stable Government. Their full effect is not immediate but it is none the less certain. They will smooth out many of the difficulties that have confronted us, and so will prepare the way for a return to a period of good trade and prosperity. The handicap of foreign competition of the character produced by the abnormal conditions which have prevailed on the Continent is one which the British manufacturers cannot effectively overcome; and whilst the resumption of normal business relationships among the various countries will not decrease the competition, it will at any rate remove much of the unfairness and artificial stimulus due to political causes. Then the knowledge that we have a Government which is likely to be of long tenure, and which is alive to the needs of industry, is likely to induce a feeling of confidence which will give the necessary impetus to our own trade revival.

The month of December has not been marked by anything noteworthy. Conditions are very much the same as those ruling in the previous month. Prices are comparatively firm, but there has been no large volume of business passing. Naturally the Christmas holidays have had their effect, always more noticeable in times of bad trade. There was very little doing in the week before Christmas, and most of the works closed down for the whole of Chrismas week, some of them for a fortnight. There will be no general resumption of business until after the New Year holiday.

Pig Iron and Hematite Markets

The pig iron market has been quiet. Sales are of small amount, but many of the makers are well sold ahead and the prospects for the New Year are not unsatisfactory. Full advantage was taken of the spurt some few weeks ago, when consumers secured their supplies for a month or two in advance, and consequently the pig iron makers are not surprised by the present lull in buying. There has been some talk of lower prices for coke, but this has come from the blast furnace side and the coke makers have not fallen in with it. Indeed, coke prices are firm and there does not appear to be much hope of a reduction. This is no doubt largely due to the knowledge of the forward sales which have been made in pig iron.

The hematite market is fairly strong. Although the actual business is not large there is more inquiry about, and makers have confidence that early in the New Year there will be a considerable increase in business, with the possibility of additional furnaces being put into operation. The whole of the present output is being consumed and stocks are steadily falling. The export trade is active.

Finished Iron Trade

The finished iron trade has been stimulated by the orders for rolling stock which have been placed by the railway companies, and the South Staffordshire makers have benefited materially. Marked bars are still in good demand. Indeed, this section of the trade has done well right through the year; the demand has been constant and prices have been maintained. It is the common and crown qualities which have suffered so much from the competition from abroad and at home. Belgian iron bars are being sold in this country at £4 to £5 per ton below the English prices, and small steel bars are about £3 per ton less. With such a difference against wrought iron, it is no wonder that the demand for forge pig iron has fallen so low. Out of a total production of pig iron in November of 583,000 tons, only 31,700 tons were forge iron.

Steel Market

There is not much to say about the steel market. The demand is still far short of the supply; and notwithstanding the cuts which are being made in prices the orders available are nothing like sufficient to keep the mills busy. The shortage of specifications is acute, and this condition favours the practice of price cutting, although there cannot be much more done in the way of reductions. There is no profit on present prices; indeed, in many instances an actual loss is incurred. The steel maker who quotes a price which will cover his cost of production and the overhead charges finds that he has little chance of getting any appreciable weight of orders, and he has either to reduce his price to meet the competition from other makers (assisted as they are by subsidiary interests) or miss the orders. One unfortunate result of this is that consumers are encouraged to hold out for still lower prices.

There is some encouragement for the steel makers in the announcement of the additional railway programmes for 1925. The work which the London, Midland and Scottish Railway has decided to undertake will involve an expenditure of about £14,000,000 and the London and North Eastern Railway is also spending about £6,000,000. The orders will be distributed amongst the various manufacturers in such a way that they will interfere as little as possible with the general trade. This work will mean large orders for iron and steel. During the past year the railway orders have been the salvation of the steel works, and it is very pleasing to know that the orders are not only to be continued but probably increased. An interesting feature is the decision to use more steel in place of wood in coachbuilding. This will help the sheet makers considerably. Already some good orders for wagons have been given out to most of the principal wagon builders.

Safeguarding of Industries

The statement made by the Prime Minister that a new Safeguarding of Industries Act will be passed is of considerable interest to the iron and steel industry. The object of the Act is to protect important and efficient industries from unfair competition due to longer hours, lower wages, depreciating exchanges, bounties, rebates and subsidies, and possibly lower taxes that those upon British industry. There is no trade to which this objects clause more directly applies than the steel trade, and the actual provisions of the Act will be closely followed by the steel makers. There is bound to be opposition to any tariff on foreign billets from the re-rollers in this country, and there will be a clashing of interests between these and the English billet makers. The present price of English billets is not a profitable one; and the re-rollers have forced down the prices of small steel bars until they are below the cost of manufacture. No tariff measure can be expected to benefit everyone, and the best interests of the steel trade as a whole will have to be considered. We notice that Sir Arthur Dorman, speaking at the annual meeting of Dorman, Long and Co., referred to the possible necessity of subsidising the export of iron and steel produced in Great Britain until an equilibrium was again restored between the British and Continental conditions of life.

Some interest has been aroused in steel circles by the announcement that the Park Gate Iron and Steel Co. of Rotherham are resuming the manufacture of Siemens Martin acid steel, which they gave up a few years ago. The Park Gate Co. have for many years advocated the use of Siemens Martin basic steel for boilers and many other purposes for which acid steel has been favoured, and they have succeeded to a large extent in overcoming the prejudice against the Siemens basic quality. However, there are still engineers who persist in their preference for acid steel, and that is no doubt the reason why the Park Gate Co. are arranging again to make both qualities.

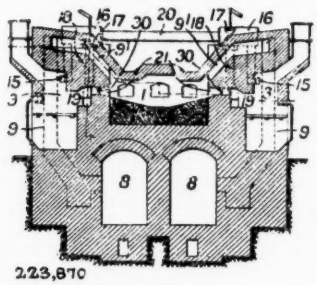
The South Durham Steel and Iron Co. is building a new galvanising works at Stockton and will shortly be in the market with galvanised sheets. The directors are also considering the possibilities of taking up other branches of steel manufacture not at present dealt with. The Consett Iron Co. also will shortly be in a position to commence the new plant which they have installed.

Some Inventions of the Month

By Our Patents Correspondent

Regenerative Open-Hearth Furnace

An application has been made by E. Bosshardt of Berlin for a patent for an improved open-hearth furnace. Air from the right hand regenerator 8 passes through passages 9, 9^1 to the hearth 1, and gas from the upper end of the generator 3 passes through conduits 15, 16, 18 to a chamber 19. This chamber opens at one side into the lower part of the generator, and at the other side through a passage 21, into the hearth 1. The waste gases pass from the hearth through the left hand passages 9, 9^1 to the left hand regenerator 8. The two conduits 16 are connected by a pipe 20, so that the gas from both generators can pass to the chamber 19. The direct passage of gas from the left hand generator into the hearth is prevented by a current of air delivered through slots 30 between the chamber 19 and the hearth. See Patent Application 223,870, having the international convention date, October 25, 1923.



Electromagnetic Separation of Minerals

A method of electromagnetically concentrating minerals is described in a patent by W. M. Mordey, of London. The core of an electromagnet is constructed with stampings of inverted T-shape, or of E-shape with the three poles extending upwards. The elongated core is wound with a single coil through which an alternating current is passed. The electromagnet thus formed is placed below a non-conducting launder on to which a thin stream of the material is delivered at one end. The launder may be sufficiently inclined for the material to flow freely along it by gravity, or it may be less inclined, and subjected to a jigging action. The cross section of the launder is slightly concave. When the separator is in action, the responsive material is repelled laterally from the middle towards both sides of the launder, while the gangue remains in the centre, or the responsive material may be repelled over the sides.

In an alternative construction, the magnet core may be shaped like a long rack with vertical teeth or poles on the upper side, each pole having its own winding. The current is preferably two-phase, and the result of the forces acting on the material is to move the material either in the direction of flow of the stream or in the opposite direction, and so separate the concentrate from the gangue. In another construction, the stream of material and the magnet pole may be vertical instead of horizontal.

This method is particularly applicable to the concentration of specular hæmatite and other slightly magnetic substances, as well as the concentration of magnetite. The use of a vertical magnet with a strong field and a small air gap between the magnet and the launder is described. See Patent No. 224,924, dated May 17, 1923.

Wrought Iron

An improved process for making wrought iron has been patented by H. Wade, London, as a communication from A. M. Byers Co., of Pittsburgh, Pa., U.S.A. In the method of making wrought iron by pouring molten steel into a slag of puddling characteristics and granulating it and forming a ball, red-shortness may appear during the rolling. It has been found that the temperature of the slag may rise above the melting point of the metal, so that granulation does not take place. The temperature of the steel may be 2,800°–2,900° F., the solidifying point being 2,730° F., and the slag temperature may be 2,200°–2,300° F., and excessive rise of temperature of the slag may be avoided by employing about 3 volumes of slag to 1 volume of metal. Alternatively, less slag may be used, and cold pulverised slag may be added to keep down the temperature. The metal and slag will then weld together to form a coherent mass.

Red-shortness may be eliminated by adding to the steel before pouring a protective metalloid such as silicon or phosphorus. About 1 per cent. of ferro-silicon introduces the necessary amount of silicon. A high-grade wrought iron is obtained by this process. See Patent No. 224,941, dated August 14, 1923.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Cast alloys of aluminium containing small amounts of magnesium. S. Daniels. *J. Ind. Eng. Chem.*, December, 1924, pp. 1243–1249. A research into the properties of aluminium-magnesium-silicon alloys which contain less than 5 per cent. of magnesium.

Notes on alloy metals used in alloy steel. J. L. F. Vogel. *J.S.C.I.*, December 26, 1924, pp. 365-369T.

Modern problems in engineering bronze founding. F. W. Rose. *Metal Ind. (Lond.)*, December 19, 1924, pp. 593–594 and p. 604 ; December 26, 1924, pp. 611–614. Deals with some problems of practical importance in the production of bronze castings.

Casting and heat treatment of some aluminium-copper-magnesium alloys. Part I. S. Daniels, A. J. Lyon and J. B. Johnson. *Brass World*, December, 1924, pp. 427–429.

CORROSION.—Film protection as a factor in corrosion. F. N. Speller. *Chem. Age, (N. York)*, November, 1924, pp. 457–459. A study of the use of sodium silicate to reduce corrosion of water mains.

ELECTRO-METALLURGY.—Modern electrolytic cells. A. J. Hale. *J.S.C.I.*, December, 12, 1924, pp. 1224–1233. Includes a description of the cells employed for the winning and refining of metals.

Electro-metallurgical applications. Part I. J. L. McK. Yardley. *Blast Furnace and Steel Plant*, December, 1924, pp. 532–535. A preliminary discussion of some fundamentals in the economic industrial utilization of power.

Studies on electro-plating. Part IV. Anodes (*continued*). W. E. Hughes. *Metal Ind. (Lond.)*, November 28, 1924, pp. 519–521 ; December 5, 1924, pp. 543–546 ; December 12, 1924, pp. 567–568. An extensive discussion of the functions and dissolution of anodes.

Ferro-phosphorus production in the electric furnace. T. Swann. *Chem. Age (N. York)*, November, 1924, pp. 469–470.

GENERAL.—The question of solidification from the standpoint of Röntgen ray research. Part I. E. Schiebold. *Z. Metallkunde*, November, 1924, pp. 417–425. The mechanism of the formation of crystalline media and its indication in the Röntgen ray picture.

IRON AND STEEL.—Bibliography of manganese steel. E. H. McClelland. *Blast Furnace and Steel Plant*, December, 1924, pp. 548–552.

The methods for the manufacture of steel, particularly from the point of view of refined steel production. W. Eilender. *Stahl u. Eisen*, December 18, 1924, pp. 1637–1644 (in German).

The properties of refined steels. P. Goerens. *Stahl u. Eisen*, December 18, 1924, pp. 1645–1659 (in German). A tabular and graphical presentation of their mechanical and physical characteristics.

Swedish charcoal iron. N. Danielsen. *Mining and Met.*, December, 1924, pp. 569–572. Its production, advantages and defects.

The micro-structure of austenite and martensite. F. F. Lucas. *Trans. Amer. Soc. Stee. Treating*, December 1924, pp. 669–691.

The recrystallisation of carbon steels and alloyed steels. W. Schneider and E. Houdremont. *Stahl u. Eisen*, December 18, 1924, pp. 1681–1687 (in German).

ANALYSIS.—Determination of chromium and vanadium in steel. L. Lindemann. *J. Ind. Eng. Chem.*, December, 1924, pp. 1271–1272.

The simultaneous determination of sulphur and carbon in steel, pig iron and iron alloys by combustion in a stream of oxygen. C. Holthaus. *Stahl u. Eisen*, November 27, 1924, pp. 1514–1519 (in German).

Stainless Steel for Chemical Plant

Its Resistance to Acids and Alkalis

THE use of stainless steel in the manufacture of chemical plant and the effect of acids and alkalis on mild stainless steel were discussed by Mr. H. S. Primrose in the course of a paper on "The Manufacture and Uses of Rustless Iron," read at the last meeting of the Manchester Association of Engineers. Stainless iron or rustless iron, said the author, was not stainless or rustless under all conditions as was generally supposed, and, moreover, was not really "iron" but a dead-mild steel containing certain percentages of chromium, which metal gave the steel its corrosion-resisting properties. The word "stainless" or "rustless" was rather ill-chosen to describe a metal which was merely untarnishable and incorrodible or rust-resisting under ordinary weather conditions, but it appeared to have been adopted because a more accurate term did not readily present itself. The material would rust under certain conditions, and this rusting was more or less according to the condition of the metal. No material had, however, been made that more nearly met the requirements in respect of corrosion resistance than did mild stainless steel.

Quite recently a new process had been evolved whereby mild stainless steel could be produced more cheaply than by the methods previously in use. The future of commercial development and wide engineering application undoubtedly lay with the low carbon alloys containing chromium. With the new method—the Hamilton-Evans process—using chromo ore and ferro-silicon, which were both comparatively cheap and easily obtainable commodities, this direct process put an entirely different commercial phase on the rustless steel industry. The cost of producing mild stainless steel in ingot form by the ferro-chromo process was about £65 per ton, but by the new process ingots were made at £30 per ton, which more than halved the first cost of the metal.

Mr. Primrose gave the following short summary of the effect of the common corrosive agents :—

Nitric Acid	Dilute nitric acid attacks slightly.
Strong Nitric Acid	Practically no effect.
Sulphuric Acid	Attacks rapidly in all strengths.
Hydrochloric Acid	Attacks rapidly in all strengths.
Acetic Acid	Glacial acetic acid has no effect. Dilute in various strengths attacks slightly. Vinegar containing 5 per cent. acetic acid has no effect.
Citric Acid	Corrodes in proportion to the strength of the acid. Limejuice containing about 6 per cent. citric acid has no effect.
Lactic Acid	Corrodes to a considerable degree. Fresh milk and sour milk, although high in lactic acid, do not attack.
Boric Acid	No effect.
Oleic Acid	No effect.
Stearic Acid	No effect.
Tannic Acid	No effect.
Ammonium Hydrate	No effect in any strength or solution.
Alkalis	No effect in any strength or solution.
Alkaline Carbonates	No effect in any strength or solution.
Ammonium Chloride	Solutions readily attack.
Ammonium Sulphate	Solutions readily attack.
Ferric Chloride	Solutions readily attack.
Copper Chloride	Solutions readily attack.
Copper Sulphate	No effect.
Chlorine	Attacks readily.
Mercuric Chloride	Strong solution has a marked effect. Dilute solution as used for antiseptics has little effect.
Lysol	No effect.
Iodine	Corrodes slightly.
Benzole	No effect.
Petrol	No effect.
Sodium Chloride	Local pitting by solutions.
Sodium Sulphate	Strong solutions attack readily.
Soap	No effect.
Potassium Ferrocyanide	Attacks readily.
Tap water	No action.
Sea-water	No effect even under alternate wet or dry conditions.
Steam	Very little effect under normal conditions. Errosion action also resisted very well.
Oils	No effect.
Greases	No effect.

One of the valuable properties of mild stainless steels was its behaviour at high temperatures. When pieces of the material which had been polished were heated up gradually, temper colours appeared on the surface similar to those obtained when ordinary carbon steels were heated up, but in the case of mild stainless steel these temper colours appeared at much higher temperatures. Up to temperatures of about 825 degrees C. mild stainless steel resisted scaling to a remarkable degree, but above this temperature the materials began to scale to some extent. Another valuable property was that at high temperatures it retained its strength much more than ordinary mild steel.

Particulars of the acid-pickling baths generally used for mild stainless steel were given.

Mr. Primrose said castings in mild stainless steel were now being produced on a commercial scale, and these castings, when de-scaled by sand-blasting and pickling, were rustless without polishing, which meant a considerable saving in the cost of production.

Fire or Furnace Sand

IN a report on "Special Sands" (No. 2646) by the U.S.A. Bureau of Mines, reference is made to "Fire or Furnace Sand," which is described as the silica or sand used to line furnace bottoms and walls, especially in those furnaces making acid open-hearth steel. A high silica content is essential, and such sand is usually called "silica sand." A small amount of bonding material is required to hold the sand in place until it has been fired or "burned in." If the sand is so pure as to be lacking in any bonding property, some bond, such as a plastic fireclay, is usually added. Many sands used for this purpose have sufficient natural bond in the form of silicates and iron oxide, usually present as limonite. A sand graded from coarse to fine is used. A small amount of fine material is desirable, as it assists in bonding, fills voids between the larger grains, and makes a more impervious hearth. Also, the finer grains sinter more rapidly when firing the new hearth. Prepared screened sands are often used, in which there are no large grains. Apparently, however, large pieces are not objectionable in all cases, as some American producers market a crushed sandstone which has passed 2-mesh screen (about ¾ in.).

Chemical analysis is important as effecting the refractoriness of the sand. Alkalis should be at a minimum; this eliminates sands containing much feldspar and mica. Clay is the best bond and the least objectionable impurity. Small amounts of iron oxide are not objectionable, and probably play an important part in the bond. As low as 80 per cent. silica sands have been used in extreme cases, but a silica content in excess of 95 per cent. is usually specified. One sample had the following analysis :—Silica 97·27 per cent., alumina 0·80 per cent., iron oxides 0·52 per cent., other oxides 0·75 per cent.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of* 1908 *provides that every Mortgage or Charge, as described therein, shall be registered within* 21 *days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

ALUMINIUM CORPORATION, LTD., London, S.W.—Registered November 27, £9,900 and £2,350 B debentures, part of £250,000; general charge. *£760,060. November 2, 1923.

BEARDMORE (WILLIAM) AND CO., LTD., London, S.W., steel manufacturers.—Registered November 26th, £250,000 deed of security, to bank. *£1,669,417 2s. 6d. October 23, 1924.

HARRIS AND FIELD, LTD., Tipton, ironfounders.—Registered December 5, £200 debentures; general charge.

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Some Practical Points on Flotation

The writer, who has had a good deal of close experience with flotation systems at the mine head, discusses some of the working points which are to be kept in mind if the utmost efficiency is to be extracted from the process.

THE ideal practical condition to adopt when concentrating sulphide ores by flotation is to use an oil mixture which will prevent the flotation of the gangue as far as possible, and yet float all sulphides present in the machine. As one of the most important points on good flotation is the combination of oils used, and as a large range of these oils are employed, it is necessary to understand their physical properties before expecting to secure satisfactory results. The agitation to which the pulp and oil have been subjected is an equally important factor, and must be correct both as regards kind and quantity. It does not require much experience for an operator to detect if an insufficiency of agitation is being applied. Where too much agitation is effected it is both difficult to recognise, and produces equally bad results. What happens in the latter case is that too much froth is formed, and also the oil loses its flotation value by being too thoroughly emulsified.

The action of the mechanical agitator is also responsible for the production of either too much or too little froth. If those engaged on the manufacture and installation of the plant have not had previous experience of the class of ore dealt with it is possible that the design will not suit the operations to be performed. The carrying power and the strength of the froth largely rest on the kind and quantity of the oil and the grade of concentrate used. A weak froth capable of carrying a sufficient amount of ore to ensure a satisfactory recovery is not likely to contain much gangue.

Where it is necessary to employ a thick or stiff froth to yield a good recovery much more gangue will be carried; consequently the product will be a much lower grade of concentrate. With different grades of concentrates the depth of froth and level of the pulp are matters of the greatest importance. When the discharge of the deep pulp level and froth is slow it results in a lengthy period for the concentration in the froth column to take place, hence relieving the latter of a correspondingly large amount of the impurities present.

Securing Best Results

To secure the maximum grade of concentrates and the highest extraction the correct depth of pulp to use cannot be worked out by any standard formula under ordinary conditions. To attain efficiency the operator must rely almost exclusively on his own practical experience, as far as the depth of froth and pulp level are concerned. One point which is generally realised, however, before very extensive experience has been gained, is that the greater the amount of ore that must be removed from the mechanical agitator, the higher the pulp level will be carried and the faster the froth will be ejected.

A correction which can be made when too little froth is being made by the machine, using the proper quantity of oil, is to blow air into the pulp at the bottom of the froth tank. When too much froth is produced, using the correct amount of oil, much more difficulty is experienced in rectifying the trouble. Many suggested remedies have been made, but as the conditions and class of materials vary so considerably, only a little light has been thrown definitely on this branch of the subject. One of these proposals simply consisted in increasing the tonnage of the machine, which is scarcely worth recording. If the pulp has been too generously oiled it will result in large quantities of froth containing mineral being found where the tailings are carried from the machine, and where they are gathered prior to retreatment. Almost all minerals have the property of adhering to flotation froth, varying widely with the different classes of ores treated. Both ore and gangue are made to float, and their separation rests on the degree with which one floats in preference to the other under known conditions.

More Complicated Flotation

When several minerals are present the work of separation by flotation is sometimes very much more complicated. It resolves itself into a process in which the most readily flotable is first attracted by and then carried on the froth. When this work has proceeded for some time, and as much mineral has been picked up as possible, the froth is removed, and the space then filled with the next most readily flotable mineral in the pulp. The proportion of froth made in the mechanical agitator is usually a fixed quantity within a given period of time. The agitator should be so run that just the exact amount of froth will be made and discharged to remove from the machine the pure mineral that is being charged, without any excess. This, of course, can only be conducted when the operator has been thoroughly skilled manipulating the machine and had daily practice at the same variety of material.

Regarding the oil itself, it might be added that a considerable amount of research work has been conducted in an attempt to determine which of the constituents were of most value in flotation. As yet, little information of any practical importance has been obtained on this point, but incidentally it appears that crude products, as a general rule, are better than any of the refined products or fractions of them. A mixture of oils usually yields better results than any one product alone in flotation work; also the removal of alkali soluble material improves their value. In conclusion, it might be mentioned that the grading of concentrates seldom approached the theoretically calculated result. Economical considerations are usually the greatest obstacles in the way of securing scientific results, and little opportunity is given in most processes for experimental work.

To summarise briefly the principal requirements necessary for reliable grading, we have efficient manipulation of the machine, careful selection of the oils used, skilful control of the depth of froth and pulp level, and accurate testing of the pulp density. So many factors influence the results in flotation that slight variations are not to be wondered at, and a perfect working process when dealing with new material is rather the exception than the rule.

Fatigue of Metals

Mr. H. J. GOUGH, of the National Physical Laboratory, addressing members of the British Acetylene and Welding Association recently, said that fatigue of metals was that process by which metals fractured under a repetition of cycles of stress or strain of less total magnitude than would cause rupture on single application. He traced the effects of many particular actions, such as the effects of machining and grinding. The finish of the material, whether left rough or smooth, had an important action and showed the necessity for a great degree of accuracy of finish if resistance to repeated stress was to be secured. Such things as cuts and scratches had a marked effect on the stresses at which metals failed.

The Corrosion of Engineering Materials

The following is a report of an interesting discussion in connection with the causes and prevention of corrosion, which was held recently by the West Yorkshire Metallurgical Society.

MR. H. R. PITT, of Wakefield, said that it seemed inevitable in approaching this subject to note that of all available materials of construction the ones most commonly applicable were the ones most susceptible to corrosion. Notwithstanding the recent discoveries in regard to stainless steels and stainless alloys, the problem in relation to constructional materials remained unsolved, and we still awaited a discovery which would give to steel the permanency of the rarer metals. The modern stainless products were extremely valuable, but their applicability was limited by their high cost, the lengthy process of their manufacture, and the rarity of their components. Some of the causes of corrosion might be enumerated at follows:—(1) Conditions inherent to the metal, which included the magnitude of solution pressure, the heterogeneity of the metal and the inclusion of foreign matter, porosity, etc. (2) Atmospheric conditions, such as varying temperature, condensation of moisture, pollution of gaseous products of combustion or other vapours, etc. (3) Conditions specially incidental to the process involved. (4) Pollution of gas or water supplies by industrial by-products. (5) Leakage of electrical circuits. (6) The formation of galvanic couples.

A consideration of the various theories of corrosion which have survived brought us to those known as the colloid theory, the acid theory, and the electrolytic theory. The colloid theory, as outlined by Dr. J. Newton Friend, was applicable only to the iron group of alloys. Seeing that iron did not rust in pure air nor in pure water, it became evident that liquid water was necessary, and that the rusting was not a process of direct oxidation. Friend divided corrosion into two classes:—(*a*) Surrosion, when products of action form deposits on the metal surface; (*b*) erosion, when the metal was attacked and reduced by solution and removal of its substance. Mechanical as well as chemical action must, therefore, be considered. This was illustrated by the effect the high explosive had on the barrels of big guns. The shell band sealed the barrel, and the entrapped gases from the explosion thus acted on the gun as well as on the shell. Gutta percha casts taken inside old gun barrels showed that in some cases furrows were made in the steel so deep that one could easily insert one's finger. This was mainly mechanical action.

The Colloid Theory

In proof of the application of the colloid theory it was advanced that—(*a*) The rate of corrosion was directly proportional to the concentration of dissolved gas; (*b*) bodies which destroyed colloids or prevented the colloidal condition retarded and prevented corrosion.

The acid theory required that an acid must be present, and carbonic acid was assumed ordinarily to effect solution as follows:—

(1) $Fe + 2CO_2 + 2H_2O = FeH_2(CO_3)_2 + H_2$

(2) $FeH_2(CO_3)_2 + H_2O = Fe(OH)_2 + H_2O + 2CO_2$

(3) 4 FeO. Aq. $+ O_2 = 2Fe_2O_3$. Aq. (rust).

The nascent hydrogen in (1) combined with free oxygen to form water, and the carbon dioxide in (2) attacked more iron. Thus the action became catalytic. In the electrolytic theory (misnamed since all reactions were electrolytic) water was the electrolyte decomposing into OH and H. Iron passed into solution in the ionic state. Carbon dioxide was not necessary, and it therefore appeared that pure water and oxygen alone brought about corrosion.

The most frequent source of serious corrosion in economisers, boilers, etc., was undoubtedly the small traces of certain organic bodies present in otherwise pure water. No softening treatment was thought necessary, and they passed in their virgin condition into the plant where, under the influence of temperature and pressure, they decomposed and produced effects on cast iron or steel identical with those of weak acids. Carbon dioxide gas was a leading offender either as an original impurity or as a product, and upon cast iron it produced the feature known as 'graphitisation." Some samples of this effect were exhibited. The graphite crust was a mixture of oxides of iron, graphite, and silica in varying proportions, and was formed whenever cast iron was slowly attacked by weak acids. Referring to these samples later, Mr. F. W. ROWE (Huddersfield) said that, judging from the microstructure of similar materials which he has examined there appeared to be present large quantities of the phosphide eutectic. In reply, Mr. Pitt said that the amount of phosphorus in cast iron scale was very small, usually about 1·5 per cent. Water containing magnesium chloride had the same effect, and it was agreed that this salt underwent hydrolytic action resulting in the production of free hydrochloric acid.

In his book on Boiler Chemistry, Paul had stated that in the case of water containing carbon dioxide some formate, such as formaldehyde, was formed, and free oxygen was at the same time liberated to attack the iron. This may be regarded as a modification of the acid theory of corrosion. In spite of great difficulties, investigation had resulted in the nature of corrosion being understood, and pointed the direction for remedies, but it was not possible to render unlimited the life of metals. Sea water would always hold certainties of attack, and there seemed little chance that on a big scale it would be possible to render all ferrous materials unassailable to the attack of the elements. Natural unalterable conditions of service made it a necessity to deal with the metal itself either in improving its composition or to protect it by an invulnerable coating. In a not inconsiderable measure regulation of methods of fuel consumption, better fuels and illuminants, the absorption of damaging products of combustion would all contribute to preserving our constructional materials—not only metals, but stone and other building materials.

"Scaling"

Mr. P. F. SUMMERS, of Leeds University, said that it was his intention to consider only one branch of this subject—namely, "scaling." The term "scaling" as applied to iron and steel denoted the formation of oxides on the surface of the metal when exposed to high temperatures. The "scaling" of iron and steel differed, therefore, from the process of "rusting," which was caused by atmospheric oxidation at ordinary temperatures. McCormick had examined the influence of various furnace gases on pieces of low, medium and high carbon steels, and found that little or no scale was formed at temperatures below 660° C., but above this temperature the formation of scale increased. He also stated that a low carbon steel would scale more heavily than a high carbon steel, and the scaling effect produced by water vapour and carbon dioxide might be reduced by the presence of carbon monoxide. McCormick concluded that there were two constituents of a "neutral" furnace atmosphere which were capable of forming scale; these were water vapour and carbon dioxide. Dickenson had compared the scaling properties of different types of steel and alloys, and concluded that the amount of scale formed under similar conditions depended upon—(1) The type of steel under examination, (2) the temperature of the test, (3) the duration of the test, (4) the furnace atmosphere. It was usual to employ the term "oxidising" to a furnace atmosphere if the products of combustion contained free oxygen; if the combustion was incomplete it was said to be "reducing"; when no excess air was present and combustion was complete, then it was regarded as "neutral." Such a neutral atmosphere could be produced by the combustion of a fuel containing only carbon and hydrogen, but the products would contain besides nitrogen, carbon dioxide and water vapour, both of which exercised an oxidising influence on iron and steel.

A furnace atmosphere which would produce a scale on iron and steel may not necessarily be oxidising towards other metals. Lellep had shown that a furnace atmosphere at a temperature of 1,200° C. which contained neither excess air nor unburnt gases produced scale on a steel needle, while a grain of cuprous oxide close to it was reduced to metallic copper. It is desirable, therefore, to employ these terms as applied to furnace atmosphere in conjunction with the metal

under treatment. The presence of carbon dioxide in the furnace gases may modify very considerably the oxidising effect on steel.

Some valuable work had been carried out by Pilling and Bedworth on the oxidation of copper, iron, and nickel, and from the results of their experiments they concluded that with base metals the dissociation pressure of the oxide was relatively small, and the metals oxidised readily even under comparatively small oxygen pressures. In high temperature oxidation as the oxide film grew thicker the rate of diffusion of oxygen through it became slower, until finally a thickness was reached at which further oxidation almost ceased at that temperature.

Corrosion in the Chemical Industry

Mr. J. B. JONES (Huddersfield), who was concerned with the result of corrosion in the chemical industry, said that the least corrodible materials were at present the most expensive. The chemical engineer wanted to get special alloys and non-corridible alloys cheaper and more reliable in properties. Ferro-concrete was going to help, as it had been proved that if a non-porous concrete was applied to steel it would protect the metal.

Mr. Pitt said that one had to consider the action of solvents on the iron and steel with which the concrete was reinforced. The concrete must of necessity be of such a quality to be impermeable to either gases or liquids, and the test of time had not yet been applied thoroughly to this composite material. Mr. Jones thought that the greatest corrosive agent was water. Dissolved oxygen enormously increased the corrosive action of water, and should be removed when possible. It was well known that the atmosphere was full of sulphuric acid coming from the combustion of coal. Rain water was thus a weak solution of sulphuric acid, etc. If only that acid water could be kept away from the metals used for constructional purposes corrosion would be prevented. One could only reduce corrosion by altering the composition of the materials exposed to attack, or by altering the composition of the attacking media. The latter object could be gained by purifying the atmosphere to get rid of sulphur fumes.

Mr. H. E. COGGON said that the effect of atmospheric corrosion had hindered the development of steel houses. The Ministry of Health had withheld its consent to certain plans because of the uncertainties of the extent to which corrosion might take place. Polluted atmosphere, which was more serious in the country than in the town, was responsible for this. Mr. Jones said that lead was the commonest material used in chemical works. For example, it was used for vessels to be used for heating sulphuric acid concentrated to about 96 per cent. The resistance of lead to attack by sulphuric acid depended on the purity of the lead and the temperature. If one took pure lead and exposed it to heated sulphuric acid vigorous action commenced at 229° C. Add 0·2 per cent. bismuth to the lead and the temperature of the action was lowered. Add 0·2 per cent. copper and one could heat the acid to 315° C. before solution began. Stirring in some cases increased corrosion and in other cases removed the deposit as it formed and prevented the action accelerating. Mr. Rowe remarked that the faster the liquid was moving the less corrosion until a speed was reached at which corrosion was prevented, but such a speed would be too enormous to be attainable in practice.

Metals under strain, Mr. Jones said, were very liable to corrosion, and therefore strain should always be removed. Condenser tubes, for example, if they were not properly annealed, were liable to rapid corrosion. He divided corrosion into three classes :—(1) Complete corrosion when the metal simply wasted away. (2) Selective corrosion when some of the product was left behind. (3) Pitting. The cause of the last effect, which was very serious, was either bad places in the metal caused by impurities or local deposits. If the inside of a boiler was perfectly smooth there would be less corrosion. Pitting was really local corrosion, which would soon produce a hole. Metals might be protected by deposition one on the other—e.g., galvanising. Steel was covered with zinc so that the latter protected the steel. If there was a hole in the zinc covering the zinc would still be attacked more readily than the steel, as zinc was more electro-positive than steel. If steel were plated with tin and a hole appeared the steel would be attacked first, as tin was the less electro-positive metal. If one could deposit lead on iron it would be very satisfactory.

The Behaviour of Alloy Steels

The speaker had tested alloy steels for corrosion and he thought that an acid-resisting alloy could be found among nickel-chrome steels. The following figures gave an indication of the way the alloys behaved :

Chromium	6%	Nickel	12%	Corrosion loss	323 units
,,	20%	,,	45%	,, ,,	199 ,,
,,	15%	,,	55%	,, ,,	25 ,,
		Stainless steel		,, ,,	1856 ,,

During the war our experts thought that Germany would have to surrender very quickly through shortage of nitrates to make explosives, but through their invention of a certain acid-resisting nickel-chrome alloy they were able to fix atmospheric nitrogen and thus carry on at least a year longer. Mr. G. LEDGARD (Halifax) said that the material mentioned by Mr. Jones was now being sold in England as a stainless steel.

Mr. E. ROWE (Huddersfield) said that he thought that the nickel-chrome alloys containing copper were more resisting than those containing iron. He depreciated the claims for non-corrodibility made for stainless steel which were usually based on a comparison with plain carbon steel, in which case the stainless steel did appear very good. Under conditions of corrosion and erosion together the stainless steels would stand up very well.

Mr. P. E. SUMMERS considered that nickel steel and many other steels made to resist corrosion had very bad mechanical properties. Stainless steel must be suitably heat-treated to resist corrosion, but even then certain acids were very destructive. Mr. J. B. Jones noted that caustic soda and potash attacked mild steel under pressure, but four or five per cent. nickel would entirely resist corrosion under such conditions. Among non-ferrous alloys which were suitable to resist corrosion by such as mine liquors and weak acids were monel metal, bronze, phosphor bronze, manganese bronze and leaded bronze. Mr. Rowe said that there was a great call for a relatively non-corrodible non-ferrous alloy which would cast well. High silicon cast iron and similar alloys resisted corrosion very well but could not be easily cast. It was not a commercial proposition to cast monel metal. Mr. Jones suggested that there was scope for investigation upon the effect of putting an oxidised surface on metals after machining was all done. Mr. Pitt said he could see little use for such treatment on a large scale, since when metals coated with oxide were put to work the oxide became detached and the metals were more easily attacked than if oxide were not present.

Stainless Steels

Mr. H. NORTH (Huddersfield) questioned whether homogeneity of metals was a necessary condition to their resisting corrosion. He instanced the heterogeneity of stainless steels and said that the more chromium was present—other constituents being equal—the more carbide would be produced and consequently the metal would be less homogeneous, yet it was less corrodible. Mr. Pitt said that in the case mentioned the surface of the metal may be quite homogeneous. Carbides were less easily attacked than ferrite and he could imagine that the outer surface of stainless steel would be a perfectly impenetrable mass of carbide of chromium which was insoluble in all recognised media. Mr. Summers remarked that Professor Cobb had shown by means of the ferroxyl indicator that impurities in iron were subject to attack and acted as centres of destruction. Complying to Mr. North's request for his views on "calorising," he said that the process was not very beneficial except at temperatures below 800° C. At a temperature between 900 and 1,000° C. the coating rapidly scaled and pitted to the interior. After a certain time and above a certain temperature the iron itself oxidised and soon gave way. Mr. H. E. Coggon said that the effects of corrosion were more serious with ferrous than with non-ferrous materials. Dealing with the protection of steel wire by means of a thin coating of oxide he said that very elaborate plant had been installed to produce a thin veneer like varnish on the wire.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Shell Manufacture Redivivus

FROM the end of the golden age to the present day iron and steel have, to a greater extent perhaps than any other material, subserved political ends and dictated policies. The war to end war having failed of its purpose, it still behoves us to keep our powder dry and to devote attention to that unblessed word "munitions." Hence we find the foreign metallurgical press still obsessed with the need for further investigation on the manufacture, for example, of shell steel, particularly in regard to explosive shells in distinction to the almost obsolete shrapnel. Mr. Portevin, a distinguished French metallurgist, has been conducting a series of researches on the variation in capacity of shells as influenced by the heat treatment to which the steel of which they are composed is submitted. The internal capacity of such shells varies considerably with the temperature at which they are hardened, and, it is important to note, by the temperature gradient between the inside and the outside of the shell when undergoing hardening. Apart from the capacity variation, any considerable difference between the temperature of the inner and outer walls leads to very severe and destructive strains in the metal. The phenomena involve what Mr. Portevin describes as the anisothermy of the mass, and the resulting unequal rates of cooling. Repeated heat treatment may have a cumulative effect. He instances the deformation which rectangular blocks of steel undergo on repeated heat treatment, which may have the effect of causing the rectilinear edges to become curved. The internal capacity of a shell may vary by as much as 2·5 to 5·0 per cent., a fact that requires to be borne in mind during subsequent machining operations. No fixed co-efficient can be derived from the investigations undertaken, and each instance has to be dealt with individually. One practical application of the research is that shells which have been found to be unduly heavy, may, by proper heat treatment, have their relative dimensions sufficiently modified to rectify such disadvantages, and hence some economy in their manufacture can be effected, and shells that might have become mere "discard" rendered serviceable.

Sulphur in Steel

A VERY considerable and well established body of evidence has accumulated during the past twenty years or so to the effect that the presence of small amounts of sulphur in steel is nothing like as baneful as it is popularly supposed to be. The myth arose as the result of faulty reasoning in the days when cause and effect were not properly understood, and certain vested interests have combined to maintain its existence. Engineers are notoriously conservative in these respects, and when life and limb may be jeopardised by any undue tolerance in the matter of specifications it is difficult wholly to blame them, although it is time that they, too, allowed themselves to be convinced by the weight of the evidence forthcoming. That certain manufacturers who have access, at economic rates, to materials of such purity that their steel is exceedingly low in sulphur, should seek to perpetuate the old legend of the evils of sulphur is not surprising. In the long run it may, however, be said with safety that the iron and steel industry suffers under this delusion, and that unnecessary expense is involved in the concerted endeavour to obtain low sulphur materials. The blast furnace business is handicapped, to start with, as many ores and much coke that could be used with impunity are discarded in favour of other grades, containing the minimum sulphur content which fetishism requires. It is not too much to say that as long as there is enough manganese present to ensure combination with the sulphur, either as manganese sulphide or as the double sulphide of manganese and iron, the existence of which is incontestable, no harm whatever could accrue from widely extending the tolerances at present allowed in respect of sulphur.

A Fetish that Dies Hard

IN this connection Mr. C. H. Ridsdale, whose conscientious accuracy and whose wide practical experience few would challenge, uttered some time ago a warning which all metallurgists would do well to take to heart. He wrote:

"Before attaching any importance to a statement in a textbook or elsewhere one should make sure, not that the writer has academical honours or literary ability but that he has actually manufactured iron and steel, conducted mechanical tests, and followed the metal up through the various working-up processes, and in its actual behaviour in subsequent use, over a large number of years."

A hard saying, but how true! What a world of trouble would be saved if the authorship of textbooks, manuals and treatises of all kinds could be restricted to those who really know, by actual experience, what they are writing about. In the meanwhile the fetish relating to sulphur, having had a good start, is repeatedly revived in current literature, the action of manganese being frequently referred to as "masking" its deleterious influence. It is probable that sulphur, in so far as to its alleged production of "red-shortness," has for many years been made the scapegoat for oxygen in steel. Indeed, the very attempts to reduce sulphur within unnecessarily refined limits may, of themselves, lead to burning and oxidation, and thus induce the very defects which it has been sought to avoid. Oxide of iron in steel is an unmitigated evil; sulphur in the presence of manganese has never been fully proved to be so. What has been proved is that a far wider tolerance would have no evil effect, and that, in regard to certain properties, such as free cutting and good surface, a small amount of sulphur appears to be actually beneficial.

"Fashions" in Coke Manufacture

As in medicine and surgery, so in metallurgy, various "fashions" prevail from time to time. Thus, a year or so ago, the subject of the reactivity of coke was all the rage, whereas comparatively little is heard of it now. The most astonishing economies in, for example, blast furnace practice were promised to those who used reactive coke, the only trouble being, first, that it was very expensive to make; secondly, that it had not been tried out on a commercial scale and was, therefore, a speculative or theoretical matter; and, thirdly, that the theory involved ran counter to accepted views, and, until ocular demonstrations proved otherwise, the theory in question was more than debatable. A critical summary by Arend and Wagner, in the *Revue de Métallurgie*, of the present views as to reactivity challenges the claims of the exponents of the method and leads to just the opposite conclusions. What, according to these investigators, is a coke of low reactivity? A reduced percentage of carbon monoxide in the blast furnace gases, with a corresponding saving of coke per ton of pig iron, can be obtained by reducing the reactivity of the coke used within the temperature interval 1,100° to 500° C. The way to achieve this is to use a dense and very hard coke, the reactivity of which is low in the temperature interval mentioned, but rises for temperatures above 1,000° C. until at 1,500° C. it equals that of the best cokes currently employed, of which American beehive coke may be regarded as typical. American practice establishes the fact that coke consumption rises enormously when by-product coke is used, the action of which on carbon dioxide is more intense. The right kind of coke can be obtained by coking the coal rapidly up to 750° C., and completing the operation more slowly up to 1,200° C. The reactivity of coke is a property which differs entirely from that of its combustibility in air, and expresses the capacity of the coke to reduce, more or less rapidly, the carbon dioxide, in accordance with the formula $C+CO_2=2CO$. Its use increases the volume of CO_2 in the waste gases and reduces the heat loss in those gases. The ideal is a coke which burns energetically at the tuyeres but possesses little reactivity at reducing your temperatures. As these conclusions are the exact opposite of the views held by the exponents of reactive coke, it will be interesting to hear what rejoinder they will make to Messrs. Arend and Wagner. The subject is one upon which the last word has by no means been said, while the need for economy—the average coke consumption in blast furnaces in this country is unduly high—is so great that the whole question deserves to come back into fashion and to be thoroughly rediscovered and tested by actual experiment.

Wireless Furnaces

DR. C. H. DESCH, Dean of the Faculty of Metallurgy at the University of Sheffield, interviewed with regard to a prophecy that within a few months there would exist in Sheffield furnaces worked by wireless valves, said that furnaces had actually been built in which the motive power for melting metal was supplied by large valves, and although their use for ordinary manufacturing processes was not likely, they had been employed for certain special nickel alloys. He explained that these valve furnaces were a development of the electrical high frequency induction furnaces—one of which was installed in the Applied Science Department of Sheffield University—using 200-volt electric current, and possessing striking advantages for experimental work. A remarkable feature of such furnaces was that electrical induction was used to generate heat within the metal itself. So successfully was that done that the metal was frequently melted before the crucible containing it was thoroughly heated.

Copper Leaching in Place

AN elaborate study of the reactions involved in leaching copper ores in place has been completed by the Department of the Interior engineers at the Inter-mountain Experiment Station of the Bureau of Mines, Salt Lake City, Utah. The object of this study was to obtain data on the fundamental conditions in the leaching process. Since the Bureau of Mines published the first description of leaching developments at the Ohio Copper Company's mine in Utah, where a large body of low-grade ore is being leached without mining, many requests have been received as to the conditions necessary to make this form of treatment successful. The experiments show how, by starting with a simple water solution, and leaching for a considerable period of time, the copper minerals go slowly into solution. Conditions under which large losses of copper might result were determined as well as methods of controlling the solution under various conditions. The tests show that practically all the water-soluble copper leaches out in a relatively short time, whereas the alteration of the copper oxides to a water-soluble form requires a long period, and the action on the sulphide minerals is very slow.

Fuel Problems in the Metallurgy of Zinc

A STUDY of fuel problems in the metallurgy of zinc is being conducted by the Interior Department at the Mississippi Valley Experiment Station of the Bureau of Mines, Rolla, Mo. Preliminary visits have been made by the investigators to a number of zinc smelting plants in Kansas, Oklahoma, and Arkansas. At these plants information was obtained concerning methods of operation, fuel problems, and refractories problems. A general study of the literature of zinc smelting and high temperature measurements is being made.

Refractory Problems in Zinc Smelting

A STUDY of the properties of the refractory materials at present used by zinc smelters in the United States for the manufacture of zinc retorts has been undertaken by the Interior Department in co-operation with the Missouri School of Mines and Metallurgy. The experimental work is being performed at the Mississippi Valley Experiment Station of the Bureau of Mines at Rolla, Mo. This study is to serve as a basis for an investigation which will have as its object the improvement of the quality of zinc retorts. The samples upon which the tests are to be made are being collected in the course of visits to various plants in connection with a survey of fuels and refractories problems in zinc smelting.

Advice to Metallurgical Students

MR. GILBERT C. VYLE, past President of the Birmingham Chamber of Commerce, addressed the University of Birmingham Metallurgical Society recently and emphasised that in many ways there were developments of commercial application to which metallurgists might turn their attention. In spite of the wonderful progress that had been made, there was a very wide field for the metallurgist of to-day and to-morrow.

Malleable castings, said Mr. Vyle, were made to-day as they were 200 years ago, when Reamur established the process. It was a long-time process. Could it not be shortened? Foundry work had altered little from its early days, and only in mechanical details. The method of melting, mixing, pattern-making, and the use of sand, were all the same. There was room for enormous economies. When was the metallurgist going to show them how to die cast at high speed ordinary iron, brass, and steel? The object of their attendance at a university was to acquire a productive profession, and the university did its part well in equipping them with knowledge. It taught them a most important thing—accurate observation. To gain that habit was worth all the time they gave to their studies. There was too much error in industry to-day, too much acceptance of apparent facts without inquiry into attendant circumstances. While a university placed a profession in their hands, it could not teach them how to apply the knowledge. That was their concern, and a vital one to them. It would be for them to apply their knowledge, but his advice was: Do not be in too much of a hurry at first. The management were often painfully aware of defects, and knew how to put them right, but the all-important matter of cost controlled everything. From the beginning of their industrial life they should co-relate all they did with the cost of doing it. If they developed a commercial sense early in their career it would help them, and keep them from wasting time on things that did not matter. Then they could concentrate on the important issues.

The Production of Sponge Iron

EXPERIMENTAL work in the production of sponge iron, conducted by the Department of the Interior at the Seattle, Washington, experimental station of the Bureau of Mines, has advanced to the point where it is believed that industrial applications of the process can be safely considered for the production of sponge iron as a metallurgical reagent for the precipitation of copper, lead, and numerous other metals from solution. In those regions remote from larger iron and steel making centres and where electric energy can be had at a comparatively cheap rate, sponge iron can also be converted into iron and steel products by melting in the electric furnace. If a piece of iron oxide is completely reduced at such a low temperature that no sintering or fusion takes place, then the piece of metallic iron formed has the same size and shape as the original piece of iron oxide. On account of the removal of oxygen, the structure is finely porous, exposing a large surface of iron, and the apparent density is less than that of the original piece of iron oxide. The material is called "sponge iron."

As a Metallurgical Reagent

When sponge iron is used as a metallurgical reagent in the precipitation of metals from a solution, the precipitation reaction takes place with greater speed than if the precipitating reagent is a massive form of iron, such as scrap or pig iron, and hence the use of sponge iron proportionately increases plant capacity. Sponge iron is likely to be of increasing importance in the hydrometallurgy of low-grade copper and complex ores. Its production ensures a permanent and reliable source of metallic iron. It is probable that the future success of large-scale leaching and precipitating processes for copper and lead depends largely upon a supply of cheap sponge iron. In the process developed through the co-operation of the Bureau of Mines and the University of Washington, almost any type of iron ore can be used for the production of sponge iron. Experiments at the Seattle station showed that similar results are obtained with magnetite, hard and soft hematite, limonite, and sintered hematite. It is probable that sponge iron will be made from such by-product materials as flue dust, pyrite cinder, various slags of high-iron content, and iron oxide sludge.

The process developed by the Bureau of Mines consists in passing a mixture of iron ore and coal through a rotating kiln heated at one end to a temperature sufficient to convert iron oxide to metallic iron, then discharging and cooling the product, and passing it through a magnetic separator to remove the sponge iron from the residual coke and siliceous material. During the past year a furnace using the Bureau of Mines process was operated commercially at Silver City, Utah, producing about three tons of sponge iron daily. Further tests of the process on a fairly large commercial scale are desired to give the data necessary for further refinements in kiln and improvements in economy of operation.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

THE New Year so far has not fulfilled the expectations of those who were looking for an expansion in trade. There is no improvement in prices and certainly no large increase in the volume of orders given out. The works which are able to keep steadily going at anything approaching normal output are very fortunate. It is to be feared, however, that even they are working at very unremunerative prices. There seems to be still a good deal of optimism, and one hears the opinion freely expressed that this year will see a decided improvement, but at present conditions are not too cheerful. Indeed one begins to doubt whether there will ever be a general revival of trade to such an extent as will keep the steel works busy all round. There may be special periods and occasions when that state will prevail, but we do not want a steel trade which can be fully prosperous only on war conditions; it is more likely that we shall have to adjust ourselves to the realisation that good trade will mean not much more in volume than it did in the good years pre-war, and with our added capacity it seems inevitable that some proportion of the plant of the country will always be short of work.

The process of increasing capacity is still going on. New mills are being put down, plants are being reconstructed or rebuilt. The Consett Co. are expected to have their entirely new plant ready for full operation this year. It is a good thing that the British steel works have been modernised, working costs reduced wherever possible, and waste eliminated to the utmost limit. It is becoming more than ever a matter of the survival of the fittest.

Continental Conditions

Conditions on the Continent are not too rosy at the moment. France and Germany have not yet reached an agreement as to the future policy of their respective iron and steel industries; and a settlement is of great importance to us. Without it there is every prospect of a period of cut-throat competition which will thoroughly disorganise the European markets, our own included. It will be a commercial war in which selling prices will have no relation to costs of production, and our home market will suffer more keenly than it has ever done. Under the best conditions, with harmonious co-operation between France and Germany, it will be no easy matter for Britain to keep her place in the export market. Belgium is very much to the fore. Her steel works have been entirely re-built on the most modern lines, and she is able to produce as cheaply as, if not more cheaply than, any other European country. Sir William Larke pointed out in his address to the London Iron and Steel Exchange that out of our productive capacity of 12 million tons of steel per annum we should require to export about 7 millions, assuming that the works are fully employed. In 1913 our exports were about 5 million tons and in 1924 they were less than 4 million tons; yet our total output in 1924 was higher by about half a million tons than in 1913. The export trade is the backbone of the British steel industry. As our productive capacity has increased so much in comparison with pre-war years, so it is essential that our exports of iron and steel should increase, not diminish.

The prospect is not too alluring when we consider the advantages which our Continental rivals possess in their depreciated exchanges, longer working hours and lower wages, and on the other hand the disadvantages with which we are faced, in the high cost of fuel, transport and taxation. The wonder is that in face of such conditions we manage to export as much as we do.

Hindrances to Trade

It is no use expecting the home demand to replace the export trade. There may be a considerable increase in the requirements for home consumption when the shipbuilding, textile and other industries recover, but even then we shall need an increased export trade. Unfortunately we are not getting too much assistance in this direction within our own Empire. India seems determined to prevent British steel from entering there, as far as possible, whilst South Africa and Australia are endeavouring to build up their own steel industries, which means a restriction of those markets for our manufactures.

On the top of all this there is the threat of further trouble with the miners. More money for less work seems to be the cry of those who are leading—or rather misleading—the men: and this at a time when it is open knowledge that the cost of fuel is one of the chief hindrances to a revival of the steel trade. No one begrudges the miners more wages if they are willing to work reasonable hours for them. We were assured a few days ago by a colliery proprietor that the cost of coal to the steel works could be reduced 5s. per ton, and at the same time higher wages be paid to the miners, if they would only work hours corresponding to those of the other industries. That 5s. per ton would be in a large measure the salvation of the steel trade. In the meantime we are threatened with a coal strike which shall involve the other Unions! It is safe to say that if such a strike takes place it will in many cases be the last straw which breaks the camel's back; and the miners themselves will be the chief losers.

The Pig Iron Market

Turning to the particular conditions which have prevailed during the month of January there is nothing special or very interesting to report. The pig iron market has shown no improvement. The furnaces are going on steadily, working off the rather heavy sales which were made towards the end of last year, but there does not seem to be any great weight of new business coming out. The export trade is very quiet. The British prices simply cannot compete with the lower prices from the Continent. The total shipments are considerably less than in December. The price of coke is firm, but in spite of this pig iron is inclined to be easier and sellers predominate.

In the finished iron trade the makers of marked bars are fairly well off for orders, although there is no great margin from one week to another. Common bars are still languishing. The new work given out by the railways will no doubt help, but it will require a lot of help to bring the iron bar trade back to anything like a flourishing condition. The old established works of George Adams and Sons, of Wolverhampton, has been definitely closed down, the owners having decided that that is the better course rather than struggle any longer against competition, chiefly continental. There are other iron works which are very near the edge.

The Steel Market

In steel, billets and bars seem to be the best features. The price of foreign billets has increased a little. In the Sheffield district the billet trade is quite good and prices are maintained. The Midlands is not so good a market for the home manufacturers. Here more of the cheap foreign steel is used, especially by the re-rollers. Steel bars are rather in demand, and although many of the orders go to the re-rollers, there is still a considerable business passing in the better qualities for which British steel is demanded. For these the price remains in the region of £9 15s. to £10. This is one of the few lines on which the steel maker can see a margin of profit. Steel sections remain at £9 to £9 5s. nominally, but for any good order that comes along there is no difficulty in getting a price below £9. Orders for steel plates are not plentiful. There is no unanimity amongst plate makers as to prices. While £9 15s. is the official price still, and is being firmly adhered to by some makers, there are others who do not hesitate to quote £9 5s. even for comparatively small orders, and we have just found an instance of a quotation a little below that for a good order. It would be a very good thing if plates could be made to sell at £9 5s. If production costs could be reduced so as to make that price an economic one the whole question would be far more healthy and hopeful.

The production of pig iron in December amounted to 580,300 tons, compared with 583,500 tons in November. The total number of furnaces in blast at the end of December was 167, being 6 less than at the beginning of the month. The output of steel ingots and castings amounted to 551,000 tons, compared with 674,000 tons in November, the increase being chiefly due to the Christmas holidays and the end of the year stocktaking. The total production for the year was 7,318,900 tons of pig iron and 8,221,100 tons of steel, compared with 7,440,500 tons and 8,481,800 tons respectively in 1923.

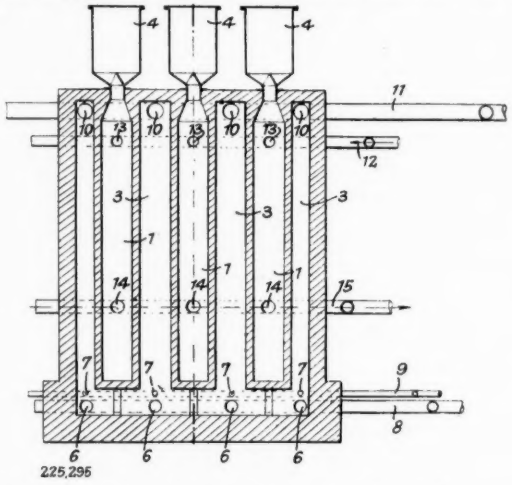
Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Reduction of Metal Oxides

A PROCESS for continuously regenerating the carbon monoxide employed for reducing metal oxides has been patented by G. Constant and A. Bruzac of Paris. The carbon dioxide from the reduction process is passed through a gas producer of the ash-melting type. The fuel is supplied from feed hoppers 4 to retorts 1, which are heated externally by means of gas supplied through a pipe 9 to the inlets 7, and air supplied through a pipe 8 to the inlets 6. The hot



gases circulate through the spaces 3 to the outlets 10 and collecting main 11. The carbon dioxide from the reducing chamber passes through the pipe 12 and openings 13 into the retorts 1 at a point when the temperature of the coke is at least 1,000° C. The coke increases in temperature towards the bottom of the retorts, and the temperature at the bottom where the ash is melted is 1,200°–1,500° C. The resulting carbon monoxide is withdrawn through openings 14 and pipe 15 to the reduction chamber and Martin furnace. The carbon monoxide may be passed through heat interchangers before supplying it to the reduction chamber. As the residual gases are at a temperature of about 800° C., any blowers or pumps which are used to circulate the gases should have their working parts cooled. Alternatively, the temperature in the retorts 1 may not increase above 1,050° C. in normal operation, and in this case it is necessary from time to time to raise the temperature sufficiently to melt and draw off the ash. See patent No. 225,295 having the International Convention date, August 22, 1922. This patent is an addition to 202,970 (see THE CHEMICAL AGE, Vol. IX, p. 465.)

Magnetic Separators

In this magnetic separator invented by H. H. Thompson, A. E. Davies, and W. Box of Birmingham, a rotary screen has a cylindrical extension of brass. A curved member carries a number of magnet poles directed radially and inwardly towards the surface of the screen extension, and these poles are alternately of opposite polarity. This separator is particularly suitable for treating material containing both large and small pieces. (See patent No. 225,751, dated March 6, 1924.)

Treating Copper Ores

A new process for extracting copper from ores has been patented by F. Dietzsch of Valparaiso, Chile. The process is particularly for treating oxidised ores such as those containing oxides, sulphates, carbonates, silicates, and oxychlorides, as well as products obtained by roasting ores and concentrates containing cupriferous sulphides, sulpho-arsenide and sulpho-antimonide minerals. It has been found that if such ores are lixiviated with a saturated solution of an alkali chloride or alkaline earth chloride containing also sulphur dioxide a very rapid solution of the copper is obtained. The ores are treated by percolation or agitation with the chloride solution. The solution of the oxidised copper is effected by the sulphurous acid, and is not due to free sulphuric or hydrochloric acid. The complex copper solution obtained is decomposed by the addition of water with precipitation of white cuprous chloride, but dilution with water has no effect on weaker solutions, and it is preferred to obtain these weaker solutions in order that the ore may afterwards be washed with water. The copper salt in solution may be completely precipitated on iron, or as a sulphide by means of sulphuretted hydrogen, sodium sulphide, or calcium polysulphide. The excess of sulphurous acid is first expelled from the solution before precipitating the copper on iron.

This process may also be used for treating oxidised gold and cupriferous ores for the removal of the copper, as a preparation for the subsequent treatment by cyanide. The quantity of cyanide necessary may thus be much reduced. Partly oxidised gold and silver ores which have not been chloridised by roasting may be mixed with an oxidising agent such as a permanganate or manganese dioxide, and then treated with a saturated alkali chloride solution which has also been saturated with sulphur dioxide to chloridise the metallic oxide. Alternatively, chloride of lime may be used with sulphurous acid as a combined chloridising and oxidising agent. (See patent No. 226,258, dated August 13, 1923.)

Disintegrating Ores

In an apparatus for disintegrating ore invented by M. McGinness of London, the ore is placed in a box which can be reciprocated by means of a crank and connecting rod mechanism. The box is of such a length relatively to its amplitude of oscillation that the material is thrown forward as a result of the movement in one direction, and comes into contact with the end wall of the box during its return movement. The dimensions of the apparatus are adjusted to obtain the maximum relative velocity at the moment of impact. The end plates of the box are adjustable towards one another, and the side walls are formed with perforated portions through which the disintegrated material is discharged. (See patent No. 226,581, dated August 25, 1923.)

Wet Magnetic Separation of Ores

A process for the wet magnetic separation of ores has been patented by F. Krupp Grusonwerk Akt., Ges., of Magdeburg-Buckau, Germany, which avoids the separation of non-magnetic particles, which usually occurs in magnetic separators working at a high circumferential speed. This is effected by supplying the raw material to the upper part of the drum separator, and also supplying water continuously to the

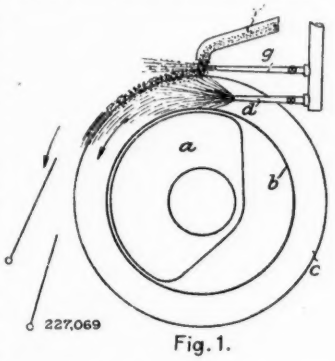


Fig. 1.

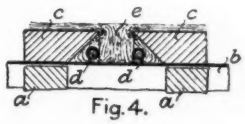


Fig. 4.

separating surface so that a liquid layer is obtained which is continually changed. The separating surface is always coated with a relatively deep layer of water at the point where the material comes in contact with it. The magnetic particles are easily attracted to the surface through the liquid layer, but the non-magnetic particles are held back by surface tension.

The magnet poles *a* are surrounded by the rotating drum *b* provided with annular auxiliary poles *c*. Water is sprayed continually from the pipe *d* against the walls of the annular chamber *e* constituted by the poles *c* and the drum *b*. The material to be separated is supplied by the shoot *f* at a point in front of the pipe *d*. Another sprayer *g* may also be provided to clean the raw material as it falls on the separator. Some modified constructions of separators and spraying devices are also described. (See patent No. 227,069, dated September 8, 1924.)

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Low melting point alloys. N. F. Budgen. *Metal Ind.* (*Lond.*), January 2, 1925, pp. 1–3, January 9, pp. 33–35. The preparation, properties, and uses of lead, bismuth, tin, and cadmium, low melting alloys, and amalgams are described.

The founding and properties of aluminium silicon alloys. D. Basch and M. F. Sayre. *Metal Ind.* (*Lond.*), January 30, 1925, pp. 105–106. A survey of the properties and production of aluminium silicon alloys.

Researches on commercial ferro-silicon. M. Bamberger, O. Einerl, and J. Nussbaum. *Stahl u. Eisen*, January 29, 1925, pp. 141–144 (in German). The behaviour in moist air is particularly discussed.

The manufacture of ferro-phosphorus in the electric furnace. T. Swann, *Mining and Met.*, January, 1925, pp. 4–5. Deals especially with the materials and types of furnace suitable.

Endurance properties of alloys of nickel and of copper. Part I. D. J. Adam. *Trans. Amer. Soc. Steel Treating*, January, 1925, pp. 54–81. "Endurance limits" have been determined for numerous alloys and including nickel, monel metal, and many bronzes.

ANTIMONY.—Experiences in the extraction of antimony from crude lead by the dry method. B. George. *Metall u. Erz*, January, 1925, pp. 27–34 (in German).

ALUMINIUM.—Smelting secondary aluminium and aluminium alloys. Part I. *Metal Ind.* (*N. York*), January, 1925, pp. 10–12. Describes the reclamation of scrap aluminium and its alloys.

CASTINGS.—Making copper castings from cupola melted metal. T. F. Jennings. *Metal Ind.* (*Lond.*), January 2, 1925, pp. 7–8. Discusses the production of copper castings free from sponginess or blow holes.

Testing castings. F. C. Edwards. *Metal Ind.* (*Lond.*), January 2, 1925, pp. 14–15, January 9, pp. 40–42. The general methods, the value of the test bar, and the importance of testing actual castings are dealt with.

COATING WITH METALS.—Recent developments in the application of metal spraying. W. E. Ballard. *Metal Ind.* (*Lond.*), January 9, 1925, pp. 27–29. Deals with the Schoop process for producing sprayed coatings of many metals and suitable for numerous industrial applications.

CORROSION.—Corrosion testing apparatus. H. S. Rawdon, A. I. Krynitska, and W. H. Finkeldy. *Metal Ind.* (*Lond.*), January 16, 1925, pp. 83–86. A number of devices for simulating atmospheric and other conditions causing corrosion are described.

CHROMIUM.—Chromium—its uses and alloys. Part IV. W. M. Mitchell. *Blast Furnace and Steel Plant*, January, 1925, pp. 26–28. Describes the effect of progressively increasing quantities of the metal in steels.

IRON AND STEEL.—Stainless iron. H. S. Primrose. *Metal Ind.* (*Lond.*), January 9, 1925, pp. 37–38, January 16, pp. 64–65. The salient facts in the manufacture, properties, and uses of stainless iron.

The effect of the presence of oxygen on the physical and technical properties of cast iron. A. Wimmer. *Stahl u. Eisen*, January 15, 1925, pp. 73–79 (in German). The preparation and properties of samples containing varying amounts of oxygen are described.

Fused salt baths for the prevention of soft spots in quenched high carbon and carburised steels. W. J. Merten. *Trans. Amer. Soc. Steel Treating*, January, 1925, pp. 23–31.

ANALYSIS.—The choice of solvents in analysis. H. C. Dews. *Metal Ind.* (*Lond.*), January 30, 1925, pp. 101–102. Recommends the method of separate estimation of each constituent in non-ferrous alloy analysis, and the freer use of more suitable solvents.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[***NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.***]

BARRONIA METALS CO., LTD., London, S.W. Registered December 29, charge to bank; charged on 10s. per share now uncalled upon 8,500 A shares in company's capital.

BENGAL IRON CO., LTD., London, S.W. Registered December 17, £100,000 debentures (secured by Trust Deed dated December 16, 1924); charged on company's works at Kulti, etc.; also general charge. *£600,000. October 24, 1924.

BROWN AND GREEN, LTD., Luton, ironfounders. Registered December 30, £2,000 debentures; general charge; also registered December 31, mortgage to bank; charged on land and premises in Chaul End Lane, Luton. *£11,566 5s. 10d. bank overdraft. August 9, 1924.

COOPER AND HALL, LTD., London, E.C., steel manufacturers. Registered December 30, £2,000 2nd debentures; general charge. *Nil. January 16, 1924.

PICKLES (T. H.) AND SONS, LTD., Mytholmroyd, ironfounders. Registered December 22, debenture to bank; general charge.

PORTSMOUTH STEEL CO., LTD. Registered December 24, £15,000 debentures (filed under section 93 (3) of the Companies (Consolidation) Act 1908), present issue £9,500; general charge. *£4,500. July 28, 1923.

ROSSELL (HENRY) AND CO., LTD., Sheffield, steel manufacturers. Registered December 13, £20,000 debentures and premium of 3 per cent.; general charge. *£100,000. November 8, 1923.

TARZAN STEEL CO., LTD., Sheffield. Registered December 18, £450 debentures, to V. Burgess, 12, Clifford Road, Sheffield, cutlery manufacturer; general charge. *Nil. September 3, 1924.

Satisfactions

BOOTH AND BROOKES, LTD., Burnham-on-Crouch, ironfounders. Satisfaction registered December 20, £1,500, registered July 5, 1907.

EVERED AND CO., LTD., Smethwick, brassfounders. Satisfaction registered January 8, £47,271, part of amount registered June 26, 1922.

PORTSMOUTH STEEL CO., LTD. Satisfaction registered December 24, £10,000, registered November 22, 1922.

Modern Methods of Metal Melting

AT a meeting of the Birmingham section of the Institute of Metals on Tuesday there was a discussion on "Methods of Metal Melting." Dr. Walters, representing the gas department, opening the discussion, spoke in favour of gas furnaces, although he did not claim that other furnaces did not have their place. During the discussion which developed there was considerable expression of opinion in support of new types of electrical furnaces, particular reference being made to high frequency furnaces. One of the speakers referred to the new type of reverberating furnace which was being used in this city, and for which quite remarkable figures were being claimed in connection with the melting of copper.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

Production and Commercial Uses of Cadmium

By N. F. Budgen, Ph.D., M.Sc.

CADMIUM is an element of comparatively recent discovery, for it was in the year 1818 that the metal was first prepared from its oxide in the laboratory of the German chemist Stromeyer, who observed that a sample of zinc carbonate obtained from the zinc works at Salzgitter yielded an oxide which, although containing no iron, possessed a yellow colour. An investigation was conducted, and the yellow coloration was traced to the presence of a new metallic oxide which could be detected in other samples of zinc oxide as well as in metallic zinc itself. At about the same date Hermann in Schönebeck, found that the acid solution of some zinc oxide, which was being employed for pharmaceutical purposes, yielded a yellow precipitate with hydrogen sulphide gas, and the authorities at Magdeburg, believing this to be due to the presence of arsenic, confiscated the entire stock of zinc oxide. Hermann investigated the subject and ascertained that the yellow precipitate was the sulphide of a metal hitherto unknown, but similar in its properties to that observed by Stromeyer. Karsten proposed to call the element *melinum* from *melinus*, a quince, on account of the yellow colour of the hydrogen sulphide precipitate. John suggested *Klaprothium* in recognition of M. Klaproth, while Gilbert proposed the name *Junonium*, in remembrance of the discovery of the asteroid Juno in 1804. In 1818 Stromeyer published an account of a complete investigation of the metal in which he described methods whereby it could be prepared, and on account of the fact that it had up to that time been chiefly obtained from the "Zinc Flowers" or "Cadmia Fornacum" of the zinc distillation furnaces, his proposal to call it "Cadmium" was finally accepted.

Ores and Sources

According to the usual acceptance of the term, there is no ore of cadmium—that is to say, there is no abundantly occurring mineral of which cadmium is the principal constituent, but certain compounds of the metal—carbonates and sulphides—are found associated in minute quantities principally with the ores of zinc, but also—though less commonly—with the ores of lead and copper. By far the greater amount of cadmium has in the past been obtained from zinc ores, but of late, the ores of lead, and still more recently the ores of copper, have yielded increasingly important amounts. Actually, however, the occurrence of cadmium in lead and copper ores is solely due to the presence in them of zinc compounds or minerals, in the absence of which the ores would be cadmium-free. The mineralogical ore of cadmium is greenockite, cadmium sulphide or cadmium-blende, a mineral of 4.5 to 4.9 specific gravity and containing 77.6 per cent. of cadmium. It is, however, of such rare occurrence that it cannot be regarded as an ore of the metal. No separate greenockite deposits have as yet been discovered, but the mineral is almost invariably found associated with sulphide and oxide zinc ores on which it forms a bright yellow coating, as in the case of ores from Bishopstown (Scotland) and Friedensville (Pennsylvania). In the Joplin district also, crystals of blende occurring in pockets or crevices are often covered with greenish-yellow deposit of greenockite. Otavite is a basic carbonate, and contains 61.5 per cent. of cadmium. This is of very rare occurrence. A cadmiferous zinc blende containing up to 5 per cent. of cadmium and having a reddish colour is called Przibramite. One of the most important sources of cadmium the world over is cadmiferous zinc ore—sulphide, silicate or carbonate as the case may be. Upper Silesia, until 1906 when the American production commenced, was the sole producer of cadmium, and obtained the metal entirely from zinc minerals which contain small traces of cadmium, recoverable as a by-product during distillation for the zinc. In blende or zinc sulphide the cadmium is present as the isomorphous greenockite, while in calamine it is present as cadmium carbonate. The oxidised zinc ores, smithsonite and calamine, generally carry a higher percentage of cadmium than does the blende in the same vicinity.

Production of Cadmium

The production of cadmium, except as a by-product where the major portion of expense of manufacture is borne by some other more commercial metal, is unprofitable. For this reason its extraction is always associated with the metallurgy of an important metal in the ore of which cadmium occurs. Now the metallurgical treatment of the ores of lead, zinc and copper for their principal metal results in the formation of a number of by-products, flue dusts, condensed fumes, etc., in which the cadmium of the ore is concentrated, and which constitute, therefore, the actual starting point for the recovery of the latter metal. From these cadmium-bearing intermediate products the metal is obtained by three principal methods:

1. Direct Distillation.
2. Solution and Electrolytic Precipitation.
3. Solution and Chemical* Precipitation.

Of these, direct distillation has in the past been the only method of commercial application, and probably still represents the principal process for recovery of the metal. In fact until 1906, when the American production commenced, the world supply of cadmium was obtained in Upper Silesia by distillation. Lately, however, electrolysis has been much perfected, and a very satisfactory process is in operation at the electrolytic zinc works of the Anaconda Mining Co., Great Falls, and at another similar plant at Risdon, Tasmania. Solution of cadmium followed by chemical precipitation is an older process than electrolysis, and has long been employed in America. The main disadvantage of it, however, lies in the fact that the cadmium-bearing precipitate which is obtained cannot by simple melting be converted to pure metal, but must be distilled in order to separate the impurities which are always present, the expense of operation being thereby increased to a considerable extent. In addition to the above, several processes have been proposed for direct extraction of cadmium from suitably prepared ores, but these for the most part find no general application.

Statistical Information

The published statistics with regard to cadmium are unsatisfactory and misleading. The figures published concerning production of the metal are reasonably accurate, but very considerable quantities of cadmium salts (notably sulphide) are recovered from residual material, and go into use in the arts without being embodied in the published statistics. In the U.S.A. certain figures are given of the production of the sulphide, but it is open to question whether they include more than primary cadmium sulphide manufactured by the principal producers of the metal. Much of the metallic cadmium is converted into cadmium sulphide as some manufacturing chemists have to rely on their own processes to ensure regularity in texture and in colour of the pigments they market. Cadmium has been produced in Germany (Upper Silesia), Austria, Belgium, the United States of America and England.

* By chemical precipitation is meant not only deposition resulting from added reagents, but that produced by presence of metal, such as zinc, in the solutions, precipitation occurring by chemical displacement.

Formerly Austria and Belgium contributed largely, but for many years Upper Silesia, where the metal was derived from zinc ores chiefly by the method of fractional distillation, has been the leading, if not the sole, producer in Europe. In 1907 production in a small way from "blue powder" was commenced by the Grasselli Chemical Co., Cleveland, Ohio, U.S.A., and in 1923 there were altogether nine operating plants. For many years following its discovery the production of cadmium must have been small, but accurate statistical information covering the first sixty years is entirely lacking. In 1860, at the works of Lydogniahütte, 201 lb. of cadmium, saleable at 6s. a pound, were produced, and from about this time onward the production, although almost entirely confined to Upper Silesia, steadily increased. The actual present American output is about 130 tons per annum, but the potential production may be estimated at rather under 300 tons. The United States production has grown rapidly, and at present is almost as great as that of Germany. The material employed in America is generally the condensed bag-house fumes from lead smelters, although a relatively small quantity has been obtained from zinc-bearing material. The chief producing states are Colorado, Utah, California, Ohio, Montana, Illinois and Delaware.

Chemical Properties

The chemical behaviour of cadmium is in most respects similar to that of zinc, it is always divalent, its vapour density at 1,040° C. is 3·94 referred to air, or 5·63 referred to hydrogen. Cadmium is soluble in dilute acids with formation of the corresponding salts—dilute nitric acid being by far the best solvent for the metal—from such solutions zinc will precipitate cadmium in a dendritic form, like the well-known "lead-tree." Goldschmidt discovered in 1905 that aluminium possesses the property of quantitatively precipitating cadmium from solutions of soluble cadmium salts in presence of a trace of chromium nitrate. The metal can also be deposited from its solutions by electrolysis. Cadmium decomposes water, forming CdO and H when its vapour is allowed to interact with steam at a red heat, but the metal is not attacked by dry air, though when exposed to damp air it rapidly becomes coated with a greyish white film of suboxide. This oxidation is, however, only superficial, the film or crust protecting the subjacent metal from further change. Cadmium is oxidised by heating with nitre and alkali carbonate; in oxygen, air and chlorine it burns in the same way as do magnesium and zinc. The spectrum of cadmium consists of brilliant red, green and blue lines, and its use has been suggested as a convenient standard in refractometry.

The salts of cadmium are for the most part but slightly dissociated in solution, this is especially so in the case of the iodide, and they are, therefore, liable to be incompletely precipitated by reagents.

The most commercially important chemical compounds of cadmium are the chloride, the sulphide, the sulphate, the carbonate, the oxide, the hydrate and the cyanide, but particularly the sulphide. The vapour of cadmium, as well as soluble cadmium salts, is highly poisonous.

Detection of Cadmium

Hydrogen sulphide precipitates cadmium from a weak acid solution as yellow cadmium sulphide, CdS. The precipitate is insoluble in ammonium sulphide (arsenic, antimony and tin are soluble), but dissolves in hot nitric acid (separation from mercury). Upon addition of sulphuric acid and taking down to SO_3, fumes, nitric acid is expelled. The solution may then be diluted with water, cadmium remaining in solution while lead is precipitated as $PbSO_4$. Bismuth is precipitated by ammonium hydroxide, and may be filtered off. Cyanide of potassium is added to prevent the precipitation of copper sulphide, hydrogen sulphide may now be led into the solution, whereupon cadmium precipitates as yellow cadmium sulphide.

An accurate method of detection involves the fact that cadmium produces a reddish-violet colour with a solution of diphenyl-carbazide in 90 per cent. alcohol, containing 2 per cent. of potassium iodide and saturated with potassium thiocyanate, the solution to be tested being first treated with sodium acetate to replace the mineral acid. This reaction will detect 1 part of cadmium in 37,000 parts of solution, and is not influenced by presence of copper or lead.

Uses of Cadmium in Alloys

The marked tendency of molten cadmium to combine with oxygen is a property which has been utilised in the melting and casting of aluminium; and although difficult of substantiation, it appears among makers of aluminium to be standard practice to add a small amount of cadmium before pouring the metal into ingot moulds, this is not generally done by aluminium foundries where finished castings are made. According to Buchalo, patentee of the process, anything from ·5 to 5 per cent. may be added to the fused aluminium, which is retained molten for some time. The cadmium being volatile, is practically eliminated from the bath before pouring. It is supposed that this treatment leads to homogenity of castings, freedom from bubbles and increased tensile and elastic properties.

Regarding copper-cadmium alloys, Smith has shown that the addition of a very small quantity (about 1 per cent.), of cadmium to copper to be used for wire, gives an alloy of markedly superior qualities to any other known conductor, whether for telephonic, telegraphic or power transmission purposes. This wire has a higher tensile strength and annealing temperature, is harder and more resistant to wear than hard-drawn copper wire, and, further, the copper conductivity is not materially impaired. Tests on this alloy used as trolley wire for tramway systems showed that its life is twice to three times that of best hard-drawn copper. One per cent. of cadmium in the wire raises the tensile strength of copper from 60,000 to 115,000 lbs. per square inch, and the conductivity is maintained at about 91 per cent., which is ample for telegraphic and telephonic purposes. The metal may be hot-rolled, and is easily prepared when the proper procedure is adopted.

An interesting application of cadmium is in the vapour arc lamp. It has been found that the addition of a minute quantity of gallium to the cadmium effectively prevents adhesion between the cadmium metal and the quartz container and thus prolongs the life of the lamp. The lamp gives an intense monochromatic red light. Very recently, a new process has been patented for the protection of piano wires, edged tools and springs, by providing them with a rust-resistant coating. Cadmium is electro-deposited upon the articles which are subsequently heat treated, and polished. It is presumed that an iron-cadmium alloy is formed during heating.

Cadmium finds application in the preparation of amalgams, the alloys with mercury, and perhaps the best-known use for cadmium amalgams is their employment in standard cells. Alloys containing cadmium are used for the manufacture of hair-springs for watches and clocks. They have many of the attributes of steel, but do not rust, and are non-magnetic. The following mixture has been recommended :—

Aluminium	90 to 96 per cent.
Nickel	0·5 to 1·0 per cent.
Antimony	0·5 to 5·0 per cent.
Cadmium	2·5 to 4·0 per cent.

Numerous mixtures for use as solders have been proposed and among them are the following :—

Lead-cadmium.
Zinc-cadmium.
Tin-cadmium.
Lead-cadmium-tin.
Lead-cadmium-zinc.
Bismuth-cadmium-tin.
Lead-cadmium-bismuth.

Of all these probably lead-cadmium-tin and lead-cadmium-zinc have proved the most satisfactory solders from all points of view. The two solders last mentioned in the above list, have very low melting points, and are used for joining tin, lead, or Britannia metal.

Silver-cadmium alloys are very suitable for the manufacture of domestic articles, as they possess remarkable malleability which permits of spinning, rolling and drawing. The so-called "arcas" plate was an electro-deposited coating of these alloys. Cadmium is employed in the manufacture of sterling silver to de-oxidise the bath before pouring. About 0·5 per cent. is used and imparts malleability and ductility to the resulting alloy.

Modern "stain-resisting" silver contains cadmium. Numerous alloys for bearings containing cadmium have been

patented, and for these a very low co-efficient of friction is claimed. Quaternary fusible alloys containing cadmium have a limited use for fusible plugs for fire extinguisher and safety devices, electric fuse wires, cliché's, and to a fairly large extent in newspaper printing, where metal copies are taken from the impression stamped in papier mâsché by a harder type set. By addition of mercury to the quaternary mixture, a very fusible alloy is obtained, and this is used by anatomists for taking casts of the human body. Fusible alloy is used for setting crystal detectors in wireless sets, and Wood's alloy containing cadmium 13, bismuth 48, lead 26, and tin 13 per cent. This alloy melts at about 60° C.

Certain mixtures of cadmium with gold give green alloys, which, like copper-cadmium-silver-gold mixtures have a limited application in the manufacture of jewellery.

Electro-deposition of Cadmium and its Alloys

The electro-deposition of cadmium is performed comparatively readily under the proper conditions, and seems to be a field offering considerable promise of expansion, though at present there is very little commercial plating of cadmium. The cadmium deposit, though soft, is harder than silver, and the colour is as white as tin, though not as white as silver. The blue tinge of nickel and also the grey tint of aluminium are absent. The surface, which takes a very high polish, is not readily tarnished by sulphuretted hydrogen and other vapours, or by prolonged exposure to the atmosphere. Cadmium is a better rust preventive than nickel, and for much the same cost cadmium plating might be substituted for nickel plating on some articles; or, as it has a slightly greater tendency to tarnish than nickel, the first coat consisting of rust preventive cadmium might be covered with a second coat of tarnish-proof nickel. Although more expensive than tin, the greater ease of deposition and superior rust-proof qualities on iron and steel, makes cadmium preferable. Cadmium electro-deposited coats adhere tenaciously, and take equally well on any metal, furthermore, no "strike" solution is necessary, nor a previous coating of copper on iron and steel. In commercial plating as also in deposition for quantitative analysis, close adhesion and compactness are of prime importance, as if this quality be lacking in the former case, there is difficulty in obtaining a high polish and good finish, and in the latter case, there will be a loss of metal from the cathode during washing with consequent vitiation of the results from a quantitative point of view.

When the electro-deposition is performed for refining or production of cadmium metal from cadmiferous solutions slight roughness is of less importance because the cathodes are stripped and melted. "Sprouts" and "trees" are, however, objectionable even in this case.

The Cyanide Plating Bath

Certain difficulties are connected with the electro-deposition of cadmium which tends to develop a micro-crystalline structure, a serious defect when the objective is a smooth and easily polished coating. As in the case of copper, the tendency can be corrected either by the use of suitable addition agents, usually colloidal, or by the employment of a complex electrolyte. In practice, the latter procedure is almost always followed, the usual bath being the complex cyanide formed by solution of carbonate of cadmium in a potassium cyanide solution. The electrolyte should contain from 1 to 4 per cent. cadmium in the form of cadmium carbonate dissolved in the minimum amount of potassium cyanide, 5 per cent. of which is subsequently added in excess. From 8 to 40 or more grams of cadmium metal per litre of solution will give a satisfactory bath. Cadmium anodes are usually employed, and uniform deposition is obtained at a temperature of 40° C., with an e.m.f. of 3 volts. Good deposits can also be obtained with a lower value than this, especially if the solution be used warm.

Temporary Vacancies at Woolwich Arsenal.

A TEMPORARY ASSISTANT and a temporary junior assistant are required in the metallurgical research department of the Royal Arsenal, Woolwich. Candidates should be graduates with university training in metallurgy. Applications for the posts should be sent, with copies of not more than three testimonials, to the Chief Superintendent, Research Department, Royal Arsenal, Woolwich, London, S.E 18.

The Inner Structure of Alloys

Cantor Lectures by Dr. Rosenhain

IN his second Cantor lecture on "The Inner Structure of Alloys" at the Royal Society of Arts on Monday, February 23, Dr. W. ROSENHAIN dealt with the interaction of different kinds of atoms when they are brought together in a single crystal, the atomic structure of alloys, he said, being the real subject of the lectures. Although pure metals were sometimes found in alloys, as a rule the constituents were either solid solutions or inter-metallic compounds. Even in the so-called pure metals we rarely found anything so pure that we could ignore the presence of dissolved impurities. The permanent and most important constituent in metals was known as the solid-solution, and that term was justified by the fact that these constituents were crystalline substances, each of the crystals being of the same homogeneous composition, not only throughout each crystal but from one crystal to another.

"Mixture Crystals"

A homogeneous crystal consisting of atoms of two kinds might be constructed in several different ways. The Germans had long called these solid-solution alloys "mixed crystals." They would be better called "mixture crystals," because "mixed crystals" suggested that the crystals were a mixture of minute crystals of the two metals. That theory was held for a long time, but evidence now entirely disproved its accuracy. X-ray analysis had shown a strict relationship between the densities obtained in this way and those obtained by direct measurement. Such a determination was made for the first time by two of his assistants, Dr. Owen and Mr. Preston, at the National Physical Laboratory, and similar measurements had been made since, and this evidence clearly proved that the atoms of the dissolved metal must be placed on the lattice of the solvent metal and not in the interstices. Thus it could be proved that the atoms were not mixed in the sense of the past theory referred to. The only case known to the contrary was the alloy of iron and carbon in the gamma region above the transition temperature. There it had been shown that the carbon atom was somehow present additionally to the iron atom on the lattice. Exactly how it was placed we did not know. It might be a case of definite chemical combination, each carbon atom being attached in some special way to three of the iron atoms, and placed interstitially between them.

If we accepted, as we must, the substitution hypothesis as being the correct interpretation of the facts with regard to solid solutions, two things must definitely follow, one of which had been experimentally established. In the first place, it was impossible to replace one atom by another and obtain an exact equivalence between the two, because atom A, which replaced atom B, would not have exactly the same attraction or repulsion force. Consequently, the atoms immediately surrounding, if they maintained their original position, would no longer be in equilibrium, and they therefore took up other positions. In other words, there was distortion which would be large or small according to the difference in character between the two atoms. This was not a question of the size of the atom at all, because the size was very indefinite, nor was it a question of the packing of the atoms. It was a question of introducing into an equi-poise system attractive and repulsive forces slightly different from those of the other atoms.

Thus the first consequence of introducing these so-called stranger atoms upon a lattice was to produce distortion. The second was that the amount of distortion which could be introduced was strictly limited. The actual amount of distortion which a lattice would stand without breaking down depended upon the energy content of the alternative arrangement which was possible. Unfortunately, it was not yet possible to write down formulæ in this respect for alloys. At the present moment X-ray analysis enabled us to get an average of inter-atomic spacing, but not the whole range between the maximum and the minimum, so that it was not possible at the moment to put down the limit of lattice distortion under any circumstances. Although the full quantitative consequences of our knowledge of solid solutions could not be worked out, certain quasi-quantitative conclusions could be drawn which were, however, open to experimental verification.

In his final Cantor lecture on "The Inner Structure of Alloys" on Monday, Dr. Rosenhain dealt with the question of the conduction of electricity through metals.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Trade Statistics

ONLY a confirmed optimist can find encouragement and support from the final figures of output and production in the Statistical Bulletin of the National Federation of Iron and Steel Manufactures for December. The output of pig iron has fallen slightly, and is now less than that of France. The production of steel is lower than it was last year. Imports have increased by well over a million tons; exports have decreased by little short of half a million tons. Prices have fallen steadily during the year. In Belgium and in France production and prices have risen, imports have fallen and exports increased. In America conditions are good and orders plentiful. The German export trade is increasing. It needs no elaborate calculation to deduce that Great Britain is losing ground in the international status it once possessed, and this is reflected in the price of shares, which, as shown in Table XIII (unlucky number!), have, on the average, fallen some 12 points since December, 1923, and are only worth something over half as much as they were in 1919. It may not be difficult to point the moral, but it is not easy to adorn the depressing tale of the last twelve months. And the moral will be unacceptable to the many!

Blast Furnace Reactions

ALTHOUGH many years have elapsed since Sir Lowthian Bell wrote his monumental work on blast furnace phenomena the questions as to how, where and precisely what reactions are involved in the reduction of iron oxides are not by any means fully and finally settled. There has always been some degree of mystery attaching to the function of hydrogen in the blast furnace. Thus, on the output side of a blast furnace balance sheet there is always a larger amount of hydrogen than can be accounted for, directly, in the materials charged and in the blast. Some, but not all, of this is derived from the dissociated moisture. In any case the presence of free hydrogen will considerably complicate the sequences of reaction due to iron oxide reduction by the carbon oxides. According to the accepted views, either Fe_2O_3 or Fe_3O_4 or FeO can be obtained, as the reactions are reversible. The water vapour may react with metallic iron, yielding hydrogen, and FeO, or hydrogen and Fe_3O_4 and either reaction will, in time, affect the reactions involving CO and CO_2. The suggestion has, from time to time, been made that some of the outgoing hydrogen instead of finding its way into the gases might be made to reduce the higher iron oxides, or, alternatively, that by increasing the moisture present the hydrogen could itself be made more readily recoverable from the gases and used for industrial purposes other than as a fuel. In the meanwhile what really happens is apt to be obscured, and further light would be welcome on a subject of such abiding interest.

Pulverised Fuel for Blast Furnaces

SOME interesting experiments have been carried out by the Roumanian Government with a view to ascertaining the extent to which coke, which is very scarce in that country, can be superseded in blast furnace practice by using cheaper fuels, such as residues from the petroleum industry. Reference has already been made to these experiments in these columns, but later details are now available. The research has been carried out by a promising young metallurgist, Mr D. Perietzeano, who has had a Western training in practical problems. In recent Swedish electrical blast furnace practice, much of the heat energy required (up to 65 per cent. of that of the coke usually employed) has been supplied by electricity, the remaining coke being used only to supply the carbon oxides necessary in the reducing reactions involved, or, at any rate, such has been the theory underlying the process. It has been with the same objects that the Roumanian experiments have been conducted. The fuel which it is ultimately intended to use is low-grade pulverised coal, but the actual experimental work has been based on the use of the petroleum residue "mazout," as the conditions under which this could be burned at the tuyeres are sufficiently similar to those obtaining when pulverised fuel is used to render the results and the experience comparable. The blast furnace selected for the experiments was a small, old-fashioned one some 40 ft. in height, and ordinarily working on charcoal. The burden contained about 60 per cent. of Fe_2O_3, and the air blast was heated to from 300° to 400° C.; the mazout itself, which has an ignition point at 136° C., being heated to between 80° and 100° C. The experiments cannot be said to have been conclusive, as only 12 per cent. of the charcoal usually employed was saved. Moreover, mazout is not a cheap substance. Useful data are, however, derivable from the investigation, which shows, first and foremost, that a sprayed fuel can satisfactorily be employed in blast furnace practice, and, secondly, the circumstances under which it can be made effective. In a larger and more modern furnace the results would probably prove more satisfactory from the fuel economy point of view. The pig iron made during the experiments was in every way equal to normal charcoal smelting practice.

Alloys for High Temperatures

THE most promising line of advance towards efficient steam raising for power generation to-day seems to be by the use of higher temperatures and pressures. Modern developments in this direction have demonstrated that thermal efficiency has been considerably increased with each increase of working temperature and pressure. Unfortunately, at elevated temperatures metals and alloys rapidly lose the properties which make them valuable from an engineering point of view, and each increase of steam temperature has brought in its train a host of practical difficulties apparently disporportionate in effect to their cause. The case was summarised by Mr. W. B. Woodhouse, president of the Institution of Electrical Engineers, who, when speaking at Sheffield lately, said that the limit to the use of higher temperatures at the present time seemed to be wholly a question of materials. Manufacturers of boilers, turbines and valves were using materials which would only stand with safety a working temperature less than about 750° F., and if metallurgists could offer something to work at 1,000 to 1,200° F. they were promised some interesting results. To surpass the present maximum mentioned by Mr. Woodhouse, at which the thermal efficiency from fuel to generator seldom reaches 25 per cent., seems highly desirable, but extremely difficult. The Barton Power Station, opened by the Manchester Corporation two years ago as one of the latest super power stations, built under the Electricity Supply Act, 1919, to feed an area of 1,200 sq. miles, contains the most up-to-date equipment it was possible to utilise. The steam temperature, however, is only 738° F. and even then the durability of the working parts is very severely taxed. The problem has not been overlooked by commercial interests affected, and many thousands of pounds have already been spent by one or two firms on research work. One of the first difficulties encountered was to devise apparatus to test in a scientific manner the mechanical properties of materials at elevated temperatures. None of the series of tests completed has been accomplished except in a laborious and expensive way, and the first results have been only of negative significance in that they have confirmed practical observation and exposed the inadequacy at a few hundred degrees above normal of all the commonly used engineering alloys.

Electric Furnace Melting

ATTENTION has lately been focussed on the exploitation of new alloys whose constituent metals have hitherto been little used for engineering purposes. The successful preparation of most of these high temperature alloys is dependent entirely on the use of the electric furnace. A temperature of 1,800° C. is necessary to fuse successfully the new alloys and no other type of furnace can melt efficiently within 200° of that required in this case. Other important considerations, even if the requisite temperature could be maintained, would prohibit the use of the older types of furnace. Many constituent metals of the new alloys are very expensive, and only the barest minimum melting loss through oxidation—to which they are more than commonly prone—can be tolerated. The liability to the formation under unfavourable atmospheric and temperature conditions of certain slags which are infusible and extremely difficult to manipulate must be also

avoided. The refractories are very severely taxed by the conditions these alloys require, and their short and precarious life in the old furnaces would bring in an unbearable expense. In these respects the easy temperature and atmosphere control and the longer life of the lining make the electric furnace of first class importance. The ores of some of the metals used to manufacture alloys for use at high temperatures could not be reduced on a commercial scale before the improvements in electric furnace design. Chromium is one of the metals so produced, for although much is now made by the aluminothermic process, its preparation in the electric furnace first made the metal accessible for its value to be assessed. Chromium is an essential constitutent in most of these alloys, nickel generally being its partner with copper or iron as the third metal.

The Combustibility of Coke

A LECTURE on "The Theories of the Operation of the Blast Furnace" was given by Mr. David Sillars, Middlesbrough, to the members of the West of Scotland Iron and Steel Institute in the Technical College, Glasgow, recently. Mr. Sillars gave a brief resume of the early making of iron, and went on to discuss the combustibility of coke. The lecturer disputed the views of Grüner and Bell with regard to the rate at which coke was consumed in the blast furnace, and considered that only in exceptional cases did the direct reduction of iron by carbon lead to fuel economy. He believed that the indirect reduction was the most economical for the smelting of most ores and especially home ores. He referred to the investigations made in connection with the rate of combustion of coke and all methods whereby fuel economy might be increased. He was of opinion that this could best be achieved by the use of hotter blast brought about by the cleaving of the gas and the application of higher velocities of the gas.

Stainless Iron

MR. HARRY S. PRIMROSE, of London, speaking to the Staffordshire Iron and Steel Institute upon the subject of "Stainless Iron," said that the words "stainless" or "rustless" were rather ill-chosen to describe a metal which was merely untarnishable and incorrodible, or rust resisting under ordinary weather conditions. They appeared to have been adopted because a more accurate term did not readily present itself. The greatest problem before the engineer was the prevention of rust, and in addition to this, the economic use of iron to avoid loss by corrosion or rusting. The importance of that would be realised by referring to the world's annual production of pig iron from 1860 to 1922, together with the yearly wastage of iron and steel due to corrosion. It would be seen that the amount of iron and steel going out of use in 1921 was almost as great as the quantity of pig iron estimated to have been made in that year. Whilst much of this was recoverable as scrap, the various forms of oxidation involved a very large complete loss each year. In that connection, special steels such as mild stainless steel was of importance, because by their aid the consumption of the metal was reduced in quantity. No material had been made that more nearly met the requirements in respect of corrosion resistance than did mild stainless steel. It had been found possible to make it in any form in which mild steel was used, and its adaptability to engineering uses and its endurance for many years without protective coatings appeared to be established.

Methods of Manufacture

THE method of making mild stainless steel in the past had been to melt mild steel scrap in an electric furnace and add the chromium by introducing ferro-chrome to the molten steel. As stainless iron contained about 0·10 per cent. and under of carbon, the ferro-chrome used had to be practically free from carbon, and as this alloy free from carbon was very costly, the resulting alloy was also expensive. Quite recently a new process had been evolved whereby mild stainless steel could be produced much cheaper. This was known as the Hamilton-Evans process. The future of commercial development and wide engineering application undoubtedly lay with the low carbon alloys containing chromium. The great hindrance hitherto to the rapid progress of commercial expansion, however, had been the high cost of production of such steel. With the Hamilton-Evans process using chrome ore and ferro-silicon, which were both comparatively cheap and easily obtainable commodities, this direct process produced an entirely different commercial phase in the rustless industry. The cost of producing mild stainless steel in ingot form by the ferro-chrome process was about £60 per ton, but by the Hamilton-Evans process ingots were made at £30 per ton. Consequently, such a process enabled the production of high chromium steels at comparatively low cost, thus ensuring the wide and extended use which they justly deserved.

Large Nickel-Chromium Plate

A NICHROME plate or sheet, 128 in. long, 57 in. wide, and ⅜ in. thick, with a weight of approximately 1,000 lb., was recently made by the Driver-Harris Company, Harrison, N.J., and is said to be the largest plate of an alloy containing a high percentage of nickel and chromium yet produced, according to *The Times* "Trade and Engineering Supplement." In view of the early difficulties of producing resistance wire and strip of this alloy, the production of a plate of this size is regarded as of commercial importance. A demand for large sheets or plates of high nickel-chromium alloy has existed for some time, but the ear y attempts were so expensive and discouraging that efforts to produce them were abandoned. Such plates would find application in the manufacture of certain containers and furnace parts and, when perforated, as screens for use in chemical sifting and ore roasting apparatus. They may be used in all services where temperatures between 1,700 deg., and 2,200 deg. F. are encountered and resistance to chemical action is required. With bi lets of suitable size it is expected that longer plates of the same alloy can be produced as easily. The method o manufacture is that usually followed in sheet production, except that in the forging, rolling, and hot flattening operations higher temperatures must be applied to the material.

Iron and Steel Industry in the Future

AT a meeting of the Committee on Industry and Trade, evidence was given on behalf of the National Federation of Iron and Steel Manufacturers by Sir William Larke. Sir William suggested that there was good reason for believing that the potential world demand for iron and steel should be sufficient to employ the full productive capacity of the world at the present time, and he attributed the difference between potential and effective demand in part to the lack of credit on the part of the consumers in all parts of the world and partly to a hope for still lower prices. From a comparison of the 1913 and 1924 imports and exports of iron and steel among the producing countries with the exports of those countries to others which were not substantial producers, he deduced that in 1924 there was a decrease of five million tons in the actual demand from the non-producing countries. The lack of demand had stimulated competition to such a degree that there was good reason to believe that in the European producing countries prices often had little relation to the costs of production. In such competition Continental producing countries had many advantages over the British manufacturer, and these the witness dealt with under the following headings:—Depreciating exchanges, lower taxation and rating, lower capital charges, lower wages and longer working hours, lower transport charges, and a protected market.

Labour Conditions

WITH regard to relations with labour, Sir William indicated the machinery established within the industry for the adjustment of differences between employers and employed, and pointed out that these had operated so effectively that no serious stoppage had originated within the industry for thirty years. Sir William referred to the efforts made by the industry to meet foreign competition, in which, by the operation of the sliding scale for the adjustment of wages, the workers also participated, and stated that their efforts had produced a remarkable fall in price levels of iron and steel products, as evidenced by the index figures prepared by the Board of Trade for January, which showed the price of iron and steel to be only 35 per cent. above the 1913 level, while "all commodities" were 71 per cent. above. He considered that befors any further substantial reduction in costs could be made by the industry there must be a general reduction in the price level in this country of all commodities and services more proportionalto that alreadyachieved in respect of iron and steel.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

ANOTHER month has passed, and as yet there are no signs of improvement in the steel trade. The best that can be said is that business is going on steadily and at about the same rate as in the previous month, the difference, if any, being a decline rather than an increase. It is a poor best. The situation can only be described as dull. There are still those who are looking for a revival before the end of the half year, but one grows rather sceptical, and has perforce to be satisfied with a steady level of trade as it is.

Price Competition among Home Makers

Although competition is as keen amongst the home makers as ever it was, there is no prospect of any official reduction in prices, and the undercutting of nominal market quotations is left to the individual choice. We do not know that that is altogether a bad policy within reasonable limits. There are local conditions affecting every works, and it is for each maker to decide what is the limit beyond which he must not go. At the same time it will be a good thing when it is possible to make buyers realise that the bottom level has been reached. Whilst an advance is out of the question, there is no reason why the present official prices should not be more rigidly maintained. They are quite low enough from the point of view of production costs, and it is not much use looking for any material reduction in these costs.

Coal, which is one of the chief items in the cost, does not offer any prospect of being cheaper. Many of the collieries are actually losing money, and yet the export trade is languishing because the English prices will not compete. Yet, if the men have their way, coal costs will increase instead of diminish. It is the same with railway rates, which constitute another important item in the cost of steel. A reduction is not likely, especially if the men succeed in their demand for more money.

The steel maker, therefore, would be justified in holding to his price. By so doing he would lose very little, if any, of the work that he is now getting. However, it appears to be too much to hope for unanimity on this point; there are too many works ready to go 5s. or 10s. below anyone else in order to capture trade. As things are, official prices are merely a sort of comparative index figure. There is not one that is not broken every day. Billets, boiler plates, ship plates, and sections all are subject to the lure of a possible order, and the keenness of the buyer is a measure of the reduction that may be obtained.

Within narrow limits that would not matter so much, but the variations are too wide. For instance, £9 to £9 5s. is still regarded as the official price for sections, but many of the orders that are now going are being placed at £8 10s. Boiler plates are officially £13 to £13 10s., but sales are being made at all sorts of prices varying from £11 up to the maximum. The buyer is at present master of the situation and he can almost name his own price.

Better Volume of Trade Needed

It is disappointing to find this condition persisting in spite of the political changes and the promise with which the year opened. We do not want a boom, but it would be very gratifying to see a better volume of trade with prospects of a steady run at that improved level. There are, indeed, some works that have found the past few weeks to show a rather decided improvement in the amount of business passing, but this trade is mostly in special qualities, particularly bars. No matter how bad times are, there are always some special branches which keep busy, and the works which cater for these special trades are reaping the advantage just now. It is the common work and the shipbuilding orders which are so scarce, and it is the lack of these that causes so much competition.

It is a good thing that the railway orders are coming on the market in a steady flow. Three of the railway groups have contracted for their iron and steel requirements to the end of this year and orders are being regularly placed with the various works. The wagon building firms are also contributing a good share to the work that is given out. The orders from these sources are by no means inconsiderable. The motor trades are also quite busy and form a bright feature in an otherwise dismal market.

Much of the work that is being done at present is against contracts which were made at the end of last year and the beginning of this. They are being worked off much quicker than they are being replaced, and the strength or weakness of the market will be made apparent when the time comes for further purchases to be negotiated.

Suggestions for Improvement

Interesting suggestions have just recently been made, from both the workers' and the employers' side, for effecting an improvement in the steel trade. Mr. Arthur Dorman, speaking at the dinner of the London Iron and Steel Exchange, advocated a conference of British steel makers and British consumers for the purpose of increasing the consumption of the home manufactured products. The suggestion was well received, but it is doubtful whether we should get far along that line. The interests of individual firms would be rather too conflicting to allow of united action to any appreciable extent, for after all self-interest is still a ruling factor. Mr. Arthur Pugh, of the Iron and Steel Trades Confederation, in his evidence before the Committee on Industry, gave it as his opinion that a system of pooling orders would lead to a reduction in the costs of production, and a joint and co-operative marketing organisation might effect economies in the services of middlemen. That, too, is an idea which so far has not been put into practice in England, although it is well known in Germany, and most of the branches of the iron and steel trades in that country have now re-established their organisations for that purpose. Judging from the experience of the price organisations here, it will need a different frame of mind amongst the manufacturers to make any such scheme a success in this country.

Pig Iron Market

The pig iron market during the month has been in a state of unrelieved depression. Orders have been scarce and prices cut to the lowest limit, but price reduction has had little effect on the weight of orders placed. We have just heard of a large consignment of pig iron being brought into this country from India, some of it being for the Lancashire market and the remainder for Scotland. We know that the cost of making iron at the Tata Works in India, from which the iron has been forwarded, is much below our cost, and no doubt a cheap freight has been obtained, but it is not very cheerful to find our own already thin market being invaded like this. The hematite market is also correspondingly quiet and prices are easier all round.

The finished iron trade is equally unsatisfactory; even the marked bar trade is sharing in the slump. Orders for the common qualities are difficult to obtain. The Belgian prices are a severe handicap to the British makers, being £3 to £4 per ton lower.

Steel billets are on the whole a little quieter, and in the Midlands and in Lancashire the price runs about £7 10s. for soft qualities. The Sheffield district has a better showing, with prices nearer £8 and a fair amount of business. Finished steel remains unchanged. Plates and sections are the weakest, and makers simply have to take what orders are offered them, irrespective of the price. There is more doing in steel bars, and the price of these offers a better return, but some low quotations are coming out. Large quantities of continental bars are being regularly sent into the Birmingham district.

A Difficult Time Still Ahead

We are afraid the picture we have drawn is not a bright one, but it is no use hiding one's face from the facts. The iron and steel trade still has a difficult time to pass through. Matters are not made any easier by the element of financial uncertainty that is evident. It is a general experience that accounts were never more difficult to get in, and a sharp upward movement in trade, if such were to occur, might find more than one firm not in a financial position to cope with it. However, we manage to carry on, and the principal works are keeping themselves thoroughly efficient and ready to meet the revivial that must come sooner or later.

Some Inventions of the Month

By Our Patents Correspondent

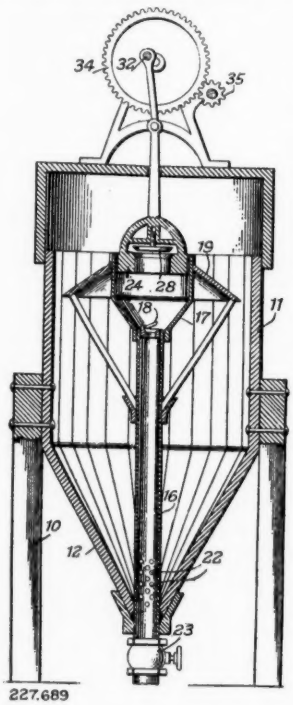
Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Extraction of Zinc Ores

A NEW process has been patented by A. Nathansohn and F. Leyser, of Bad Harzburg, Germany, for treating roasted zinc ores or metallurgical products so that the zinc can be more effectively lixiviated. Such ores have part of the zinc in the form of zinc ferrite, which is insoluble in acids, and the sulphur is in the form of sulphates. If mixtures of chlorides of alkaline earth metals (including magnesium), together with acids are used for the extraction, the zinc is dissolved, and if the concentration of the alkaline earth chlorides is sufficiently high, the iron present in the ore is also dissolved. A suitable concentration of calcium or magnesium chloride is 250–300 grams of chlorine per litre. The amount of acid, *e.g.*, hydrochloric, added to the solution preferably corresponds to the content of zinc and iron. The roasted ores may be subjected to a previous extraction with acids to dissolve out the readily soluble metals, and about 80–85 per cent. of the zinc may be extracted in this preliminary operation. The metals extracted by the chloride-acid lixiviation may be recovered by cooling, precipitation, electrolysis, etc. A detailed example is given of the treatment of roasted Rammelsburg ores containing 20 per cent. of zinc and 10 per cent. of lead. See patent No. 227,301, dated February 18, 1924.

Cyaniding Devices

A cyaniding tank which gives an improved circulation of the cyanide with the material to be treated has been patented by G. E. C. Rousseau, of Sacramento, Cl., U.S.A. A vertical tank 11 is provided with a tapering bottom 12, through which a vertical pipe 16 passes. The upper part of the tank contains a cylinder 17, having a flap valve 18 at its lower end seating on the top of the pipe 16. A conical member 19 projects outwards from the cylinder. Perforations 22 are provided in the pipe 16 at its lower end for a circulation of liquid, and also for its discharge through valve 23. A piston 24 is reciprocated within the cylinder 17 by means of a connecting rod 32 operated by gearing 34, 35. A disc valve 28 is mounted in the piston.



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The slimes and cyanide solution are run into the tank from the concentrating table, and the piston 24 is reciprocated so that the material in the tank is drawn upwards through the perforations 22 and pipe 16, and is then discharged over the platform 19 and so returns to the tank. The heavier particles are precipitated to the bottom of the tank and pass out through the openings 22. See patent No. 227,689, dated April 24, 1924.

Metallurgical Furnaces

The hearth of a metallurgical furnace invented by Vacuum Schmelze Ges. and W. Rohn, of Frankfurt-on-Main, Germany, comprises a dry granular refractory material such as quartz sand, alumina, magnesite or bauxite which is filled in below and behind a metal template which melts when the furnace is put into use. If the working temperature is too low to frit the refractory material a small quantity of glass powder, ground iron oxide, ground slag, boric acid, borates or silicates may be added. A hearth for melting nickel copper and nickel copper zinc alloys consists of quartz sand and 2 per cent. of powdered glass or 3 per cent. of boric acid. See patent application 226,801 having the International Convention date, December 24, 1923.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

COBALT.—Cobalt: its production and uses. T. H. Gant. *Metal Ind.* (*Lond.*), February 6, 1925, pp. 131–133; February 13, 1925, pp. 159–160 and p. 166; February 20, 1925, pp. 183–186; February 27, 1923, pp. 207–209. A complete and authoritative survey of the subject, particularly as regards cobalt steels.

ELECTRO-DEPOSITION.—Studies in electro-plating. W. E. Hughes. *Metal Ind.* (*Lond.*), January 23, 1925, pp. 77–80; January 30, 1925, pp. 103–104; February 6, 1925, pp. 137–138; February 13, 1925, p. 155. In these papers, the author discusses the use and care of anodes.

The electro-deposition of manganese. Part II. A. J. Allmand and A. N. Campbell. *Trans. Faraday Soc.*, December, 1924, pp. 379–384. A determination of the optimum conditions for deposition.

Plating aluminium. C. H. Desch and E. M. Vellan. *Metal Ind.* (*Lond.*), February 27, 1925, pp. 209–210 and p. 214. Describes the electro-deposition of cadmium, iron and nickel on aluminium.

IRON AND STEEL.—The structural composition of cast iron. A. Logan. *Metal Ind.* (*Lond.*), February 13, 1925, pp. 163–165, and February 20, 1925, pp. 189–192. An explanation of the variation of the properties of iron with chemical composition.

Comments on the making and use of alloy tool and special steels. J. A. Mathews. *Trans. Amer. Soc. Steel Treating*, February, 1925, pp. 147–167. A general résumé of the development of the tool steel industry.

Pickling of steel. Part I. C. A. Edwards. *Blast Furnace and Steel Plant*, February, 1925, pp. 79–83. Examination of the conditions of hydrogen diffusion through steel.

The chemistry of iron and steel. Part I. F. T. Sisco. *Trans. Amer. Soc. Steel Treating*, February, 1925, pp. 197–216. A discussion of the occurrence, importance and relation of the common elements in iron and steel.

Malleable cast iron manufacture. D. Wilkinson. *Metal Ind.* (*Lond.*), January 30, 1925, pp. 112–114 and p. 122; February 6, 1925, pp. 141–142. Discusses the grading, casting and annealing of malleable iron.

ALLOYS.—The founding and properties of aluminium silicon alloys. D. Basch and M. F. Sayre. *Metal Ind.* (*Lond.*), Part II, February 6, 1925, pp. 134–136; Part III, February 13, 1925, pp. 156–158; Part III, February 20, 1925, pp. 181–183.

Gold alloys. N. F. Bugden. *Metal Ind.* (*Lond.*), February 13, 1925, pp. 153–155. Discusses the properties, preparation and uses of the alloys used in the jewellery trade.

Endurance properties of alloys of nickel and of copper. Part II. D. J. McAdam. *Trans. Amer. Soc. Steel Treating*, February, 1925, pp. 217–236. An investigation of the influence of cold working on the endurance properties of a few alloys, and a discussion of the influence of chemical composition on those properties.

GENERAL.—The trend in physical metallurgy. C. H. Mathewson. *J. Franklin Inst.*, January, 1925, pp. 37–50.

The science of metals and physical research. J. Czochralski. *Z. Metallkunde*, January, 1925, pp. 1–11 (in German). A survey of the phenomena of strain in metals, with particular reference to X-ray analysis.

CHROMIUM.—Chromium: its uses and alloys. Part V. W. W. Mitchell. *Blast Furnace and Steel Plant*, February, 1925, pp. 95–96. Discusses non-ferrous alloys of chromium and chromium coatings.

TESTING METALS.—Modern machines for testing metals. H. Dronot. *La Technique Moderne*, February, 1925, pp. 65–77 (in French). An illustrated description of the latest machines for testing metals as regards hardness, resistance to shock, elasticity, bending, twisting and endurance.

Non-Ferrous Metals Research

THE future of engineering and electrical progress depends in no small measure on advances in our knowledge of metals, and the subject is, therefore, of considerable importance to the community. In this connection the work of the British Non-Ferrous Metals Research Association, of 71, Temple Row, Birmingham, is of interest, as it provides an organisation by means of which the financial support of individual firms is pooled to foster research, the funds thus rendered available being augmented by a contribution from the Government Research Department.

The present position of this Association has just been reviewed, and its research work, on which £16,000 per annum is now being expended, is described in a report just issued. Some twenty-five investigations have been put in hand, at the National Physical Laboratory, Research Department, Woolwich, the Universities and in the works. Brief and clear descriptions are given of the aims, progress and practical applications of the individual researches, which cover a wide field. Several deal with copper and brass, others with aluminium, zinc, lead and nickel; whilst metallurgical problems of great importance to engineering are being attacked, including the prevention of the wastage of locomotive fire-box stays, the search for alloys suitable for high temperature service, and die casting alloys. Other investigations are in hand on the soldering of metals and on atmospheric tarnishing and corrosion, which affect even wider interests including the building industry and even the eventual public and private user of metal construction and appliances.

Further sections of this interesting pamphlet show how successful the Association has been in securing the co-operation of leaders in the industry with the foremost scientific metallurgists, and give some indication of the rapidly accumulating results of the work. Now that it is firmly established, the Association is anxious gradually to become self-supporting, by an accession of new members from the non-ferrous industry itself and from the engineering and other users who stand to benefit by the results of its labours. It is clear that much of the work described can only be undertaken by the co-operative effort of the industry, and it is hoped that more will share in the obligations and privileges of carrying it out in steadily increasing measure. Such research already embraces some fundamental scientific work, but is mostly concerned with the direct application of science to practical problems, and one can readily believe that it is on such foundations that new industries arise and old ones become rejuvenated.

Swaledale Lead and Witherite Mining

AN attempt is now being made to revive the lead mining industry of Upper Swaledale. At one time lead mining was a prosperous industry in that district, but the mines were worked out, and the dependent population dwindled. It has been deemed impossible to revive the industry by reworking the old mines, and the present enterprise, under the direction of Captain E. C. Vickers, suggests great possibilities, as it is proposed to strike virgin ground and start a new mine in the district. Captain Vickers, who has had considerable experience in metalliferous mining, does not propose to devote his entire attention to the winning of lead. There is another mineral to be found in the district, known as witherite, Witherite is a mineral that is relatively rare; it is generally isolated in pockets along the course of barytes veins, though occasionally it is disseminated in small particles throughout a lode. In Britain only three workable veins, with witherite as the main constituent, are known. Witherite is in chief demand as a mineral from which all kinds of barium compounds can be made. It is sold to chemical manufacturers as "crude lump," and subsequently converted to barium chloride, oxide, nitrate, and other salts. Various uses for the product appear to be in the treatment of wall-papers, in coating oilcloths and linoleum, glazing pottery, and enamelling iron and steel. It has also been employed in the glass industry, and formerly in sugar refining, in which, however, it has been largely replaced by strontianite, owing to its poisonous nature, a characteristic which has led to its being made a constituent of rat poisons.

Iron Ore from Northamptonshire

SCHEMES for the extensive development of the iron ore deposits in Northamptonshire are under consideration by certain steel producers on Tees-side. If the parties concerned can obtain an economic rate from the railway companies then large quantities of iron ore will be brought from Northamptonshire to Tees-side. Last year approximately 250,000 tons of ore went to Tees-side from this country.

Northampton ores can be satisfactorily used in Tees-side furnaces for the production of basic and foundry irons. If it is found possible to transport the ore without adding too much to the initial cost of the raw material, the future is certain to witness a large increase in the use of Northamptonshire ore on Tees-side.

Austrian Steel Industry Improving

THE Austrian steel industry is beginning to show signs of improvement. The "Alpin Montan" Co., the largest ironworks in the country, are engaging several hundred more workmen, and have been running three blast furnaces since the beginning of this month.

The Royal Institution

A GENERAL MEETING of the members of the Royal Institution was held on Monday, Sir James Crichton Browne, treasurer and vice-president, in the chair. The special thanks of the members were returned to Mr. Frank Scudder for his valuable gift of specimens prepared by Faraday for his research on gold films. Mr. J. Berry, Mr. T. J. Cheater, Miss E. A. Fletcher, Professor A. Fowler, Mr. F. H. Hamilton, Dr. H. Hartley, Dr. J. C. Hunsaker, Mr. A. Jaffe, Lady Jones, Mrs. M. J. Moberly, Mr. P. J. Neate, Mr. A. L. Patterson, Mr. H. C. Pridmore, Mr. Harold Samuel, Lady Schooling, Mr. H. Gordon Selfridge, Junr., Mr. R. F. Sharpe, Rev. W. Hodson Smith, Mr. E. H. Storer, Mrs. W. J. Tennant, and Miss Ida Woodward were elected members.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[***NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.***]

BRITISH ALUMINIUM CO., LTD., London, E.C.—Registered January 23, £1,000,000 debentures (inclusive of £800,000 prior lien debentures issued in October, 1910) (secured by supplemental Trust Deed dated January 20, 1925), charged on certain properties, shares, etc; also general charge. *£667,800 prior lien debentures, £587,190 debenture stock. April 11, 1924.

WELDING, SON AND CO. (VAUXHALL), LTD., Liverpool, iron merchants.—Registered January 31, £1,000 debentures; general charge.

WEST DON STEEL CO., LTD., Sheffield.—Registered January 30, charge to Bank; charged on 39, West Don Street, Sheffield.

WYCLIFFE FOUNDRY CO., LTD., London, S.W.—Registered February 4, £7,000 C debentures; general charge. *£19,500. November 6, 1924.

Satisfactions

BRYN WORKS, LTD., Ynysmeudwy, iron manufacturers.—Satisfaction registered January 30, £14,780, registered March 26, 1902.

DAVY BROTHERS, LTD., Sheffield, ironfounders.—Satisfaction registered February 4, £30,000, registered November 12, 1903, October 24, 1917, and July 24, 1918.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

Corrosion of Metals: Recent German Research

From a Correspondent

THE literature on metal corrosion is growing at an alarming rate. During the last few years there has been an almost continual stream of books, reports and articles on this subject, and the flood shows little sign of abatement. Among recent publications are the Seventh Report of the Institute of Metals; a comprehensive report on the Electrolytic Theory of Corrosion, by Wilder D. Bancroft, reprinted from the *Journal of Physical Chemistry* (U.S.A.); the book by U. R. Evans, on Corrosion of Metals; and a report from the German Chem.-Tech.-Reichs. Dr. Newton Friend has just recently lectured on the subject, and early this year one of the American scientific societies will have a symposium devoted to the same problem. The importance and complexity of the matter fully justify all this research, assuming that the actual research is in proportion to the output of literature and discussion.

The great German scientific institute, the Chemisch-Technische Reichsanstalt (C.T.R.), corresponding to our National Physical Laboratory (N.P.L.), has been for many years engaged on this work in its metallurgical division. The view now appears to be generally held that both electrochemical and purely chemical processes play a part; and since Nernst introduced the idea of solution tension of metals there has been a tendency to associate corrosion primarily with the solution of ions. That is to say, small portions of metal in the form of positively charged ions pass into solution as soon as they come into contact with a suitable electrolyte. An electrical interface is thus formed between the negatively charged metal and the positively charged ions. The theory of Nernst is pretty well known and is fully developed in the *Zeit. f. phys. Chem.*, 47, 52 (1904).

This electrolytic view of corrosion would be comparatively simple if no chemical reactions took place at the interface of metal and electrolyte, producing considerable disturbance and complication; and if, further, the metal were electrochemically homogeneous, so that there could be no differences of potential due to impurities or differences in structure. Impurities would seem to play an important part, for chemically pure metals are much more difficultly attacked by acids than metals containing impurities. An even more important consideration is the composition of the electrolyte in which the metal is immersed, or, more generally, the nature of the chemical conditions to which the metal is exposed.

If, owing to solution tension, an atom breaks away from the crystal lattice and passes into solution as a positively charged ion, combining with the anion of the electrolyte, then the kation of the electrolyte, usually hydrogen, is set free. The degree of solubility of the metallic salt thus formed is of primary importance in determining the progress of corrosion. If the solubility is high then no protective layers will be formed and solvent action will continue. If, on the contrary, it is low the metallic salt will be quickly precipitated and a protective layer will be formed. The extent to which this will take place depends again on the physical structure of such a layer, whether it be crystalline and easily penetrated, or whether it be colloidal and therefore much more impervious. The formation of these layers may sometimes effectively disguise the true electrochemical nature of the metal, as, for example, zinc, which has a high solution tension and under suitable conditions may behave as one of the noble metals. From these and other considerations Maass and Liebreich, of the metallurgical department of the C.T.R., and authors of numerous papers on the subject, conclude that the electrochemical characteristics of the metals usually employed in the manufacture of apparatus are relatively unimportant compared with the chemical aspects of the problem. But surely two of the most important considerations are the purely physical ones of temperature and the existence of internal strain in the metal. The immediate and proximate cause may be chemical, but the remoter and more fundamental factor is physical. However, it is not possible to generalise or separate the physical from the chemical, for both are intimately related. As Maass points out, each metal must be separately examined under definite chemical and physical conditions, for these conditions, including, e.g., solubility, adsorption and physical behaviour generally, are practically unknown.

This much appears to be certain at least, namely that the nature of the anion in the electrolyte, the concentration of hydroxyl ions and oxygen content are dominant factors and determine whether the corrosion product shall be a sulphate, hydroxide or oxide; the oxygen content also determining, of course, the atomicity of the compound. If oxygen be entirely excluded, so that kathodic hydrogen only is present, nearly pure metal goes into solution, but if oxygen be gradually introduced then the corrosion product, e.g., iron oxide, is diatomic or triatomic. If the reaction be slow, as is the case with iron, the various stages of oxidation may be observed, but if rapid, as is the case with chromium, the intermediate stages are hardly noticeable.

The electrical state of the metal is also of great importance. The metal is usually thought to be free from outwardly induced electrical charges, but this is only rarely the case. Even though the metal be seldom exposed to any appreciable electrical influence, yet a very small stray current, or contact with other metals, or internal strain, is sufficient to polarise the metal. Under such small electrical charges, corresponding indeed to the order of magnitude of a residual current, the metal becomes either anodic or cathodic, and this has considerable bearing on the rate of corrosion.

It has been generally held that if the metal undergoes anodic polarisation the risk of corrosion is increased, whilst if cathodic polarisation ensues corrosion is to some extent inhibited. Research at the C.T.R. goes to show that this holds good for anodic polarisation except perhaps in the case of chromium. But to suppose that cathodic polarisation is protective is erroneous in the case of residual charges, i.e., of the order of magnitude of 10^{-6} to 10^{-7} amp/cm^2. Protection is only afforded by cathodic polarisation when hydrogen is evolved at the surface of the metal, but before this happens the metal passes into solution at an even higher rate than when free from the charge, and solution increases with increasing potential until hydrogen can be freely evolved.

Whether the metal during this solution stage forms hydroxide or other salt, or both simultaneously, depends on its chemical environment. If hydrogen is evolved then the hydroxide, or more generally the metallic salt, is reduced. A weak cathodic polarisation may, under certain conditions, be more injurious to the metal than anodic polarisation. In the important case of condenser tubes it has been definitely established that local corrosion is greatly intensified by the existence of weak stray currents or potentials (Maass u. Liebreich, *Zt. f. Metallkunde*, 1923, 245). This electrical factor is not easily avoided.

The physical condition of the so-called protective layer formed in the initial stages of corrosion may next claim brief notice. Its protective efficiency naturally depends mainly

on its imperviousness. The layer is seldom completely impervious; in fact, corrosion proceeds underneath the layer at a still greater rate, probably due to the adsorption of hydrogen by the layer itself and the consequent formation of local currents. If air is dissolved in the water or other liquid hydrogen peroxide may be formed and be acted on by the corrosion products, thus further favouring corrosion. But these and other interesting theories require testing and confirmation—or disproof.

The practical question as to the best means of averting corrosion remains exceedingly difficult. The methods hitherto employed, including the provision of metallic protective layers, or organic protection in the form of special bituminous paints, are only partially successful. The preparation of alloys with a view to reducing electrical complications is perhaps more promising, as for example in the case of chromium alloys, or stainless steel and iron. The great difficulty here is to afford protection against corrosion without at the same time bringing in other serious disadvantages which more than cancel the advantage of increased resistance to corrosion.

Properties and Uses of Alloy Steels

By an Engineer

THE demands put forward by engineers for hitherto unthought-of qualities in the materials which they use have resulted in an extensive range of alloy steels with widely varying and useful characteristics. The demand for steels with a greater resistance to abrasion and severe shocks, strains and stresses, has necessitated the use of various alloys, such as nickel, chrome, vanadium and molybdenum, which, when added to the steels in proper proportions, produce physical characteristics far beyond those possible in straight carbon steels. Metallurgical research has so far very well kept pace with engineering ingenuity. The amazing evolution of the motor-car is largely responsible for the highly efficient present-day production of alloy steels that have met such demands.

The quality of alloy steels going into the manufacture of motor-cars has advanced as the needs for greater strength, longer wear, less bulk, and less weight became necessary. Alloy steels are used now for such parts as gears, spindles, axles, steering arms, crank and cam shafts, connecting rods, transmission shafts, spline shafts, drive shafts, piston pins, bearings, cylinder head bolts, connecting rod bolts and a host of smaller parts. The superiority of alloy steel leaf springs has been responsible for their adoption in many industries where such parts are used. In ordinary steels brittleness has always been associated with extra hardness. In alloy steels hardness and toughness are pre-eminent qualities that go side by side, resulting in the use of alloy steels in products requiring some form of cutting edge, such as shear blades, axes, chisels, shovels and trowels.

The most universal alloying element used in the manufacture of special steels is chromium. Closely related to iron, the basic element of all steels, chromium so completely changes the resulting material that radical variations in applications of the resulting steels are possible. The applications of chromium in producing a complete series of alloy steels was the result of study of the alloying element and the various deoxidisers or materials used to finish the purification process in open hearth manufacture.

Chromium steel (C 0.10–0·20; Mn 0·35–0·65; S 0·04 max.; P 0·04 max.; Si. 0·25; Cr. 0·55–0.75) has been produced for the special requirements of carbonisers, and is produced under conditions which ensure uniform machining, carbonising and hardening properties. It is used for such parts as hardened gears, pins, shafts, roller bearings and all parts requiring a very uniform, hard case.

By increasing the percentage of chromium from 0·55–0·75 in the steel just referred to up to 0·8–1·0, and varying the drawing temperature, a steel with almost any strength between 95,000 and 200,000 lb. per sq. in. can be obtained. Such a steel is suitable for production forging, and is being used successfully for front and rear axles, steering knuckles and arms, crank and drive shafts, connecting rods, valve stems, spring clips, highly stressed shafting and machine parts subject to heavy shock.

If another 0·1 per cent. chromium is added, with 0·3 per cent. more carbon and 0·10 per cent. more manganese than in the last steel a chromium alloy steel is produced which, in thin sections, is oil hardening, and is, therefore, well suited to the manufacture of small oil hardened gears whose clean machined surfaces harden uniformly with very little distortion.

A good carbonising grade of nickel steel (C 0·10–0·20; Mn 0·50–0·80; Ni 3·25–3·75; S 0·045 max.; P 0·04 max.) has wide applications. It must be free from lamination, have the proper structure to permit machining, must carbonise uniformly and harden without distortion. Such a steel is used for differential gears, transmission gears and all parts requiring extreme hardness and freedom from distortion when quenched. With a slight increase in carbon and the same percentage of nickel and water-quenching at 1,450 deg. F. instead of oil-quenching at 1,500 deg. F., as in the former case, a steel is produced in which the strength is increased without any sacrifice of ductility, making it suitable for all work where high stress is encountered. Such a steel can be used regularly in highly stressed bolts, nuts, turn-buckles, machinery parts, and all parts requiring toughness. This type is not water-quenched when high in carbon unless the sections are more than about 1¾ in. diameter; sizes smaller than this are quenched in oil.

When chrome and nickel are combined in a steel (0·5–0·8 Cr and 1·0–1·5 Ni) the best properties of each are brought out, and it is possible to produce a steel differing entirely from either chrome or nickel steel. When well made these chrome-nickel steels are readily machined, carbonise uniformly with proper diffusion of carbides in the case, and harden uniformly without distortion. Such steels are used for carbonised differential gears, transmission spline shafts, roller bearings and parts in which crushing of the case is an important factor.

A water-quenched chrome-nickel steel can, with proper treatment, be made to give excellent impact-resisting qualities. The ability of such a steel to withstand alternating stress up to high limits, makes it admirably suited for axles, drive shafts, steering arms, steering knuckles, pump shafts, highly stressed bolts, nuts, and all parts requiring a high factor of safety in design.

The full value of chromium in a steel is brought out when vanadium is added (C 0·10–0·20; Mn 0·50-0·80; Cr 0·80–1·10; Va 0·15–0·20; S 0·045 max.; P 0·04 max.). The high speed possible in carbonising chrome-vanadium steel makes it especially desirable in the large production of carbonised parts. The resulting uniformity makes such a steel suitable for differential gears, driving pinions, universal yokes, piston pins and steering worms. An excellent steel for mass production work is obtained by a slight increase in the carbon content (from 0·1–0·25) of the previous steel. Under conditions of excessive temperature this steel does not suffer as quickly as some types, and it is well suited for front axles, steering knuckles, crank shafts, connecting rods, drive shafts, axle shafts, and steam hammer piston rods.

The use of molybdenum in combination with nickel in carbonising stock has permitted radical changes in many case-hardened parts. Originally applied to the production of oil-quenching carbonised parts where file hardness was essential, the glass hardness obtained led to many other applications, and the ability to produce full file hardness by open tank oil-quenching, thus eliminating distortion, has simplified many production problems. The machineability of this grade increased tool life in automatic machines to such an extent that this alone has been the reason for its adoption in many cases. Offering, as it does, the possibility of producing tough cores with a single quench in oil, this steel possesses the fundamental properties required to solve many problems existing in the production of carbonised parts where a deep and exceptionally hard case is necessary. The composition of such a

steel is: C 0·1–0·18; Mn 0·3–0·5; S 0·04 max.; P 0·04 max.; Ni 1·40–1·70; Mo 0·20–0·30. By combining molybdenum with chromium a steel can be produced which does not crack in water-hardening and which gives very uniform results in drawing. Such a steel is suitable for steering knuckles and similar parts.

In the production of such parts as locomotive side rods and axles, very intricate machine parts and difficult heavy forgings, there is a demand for a steel which will air harden to some extent. Such a steel must show good physical properties on cooling from normalising heat, and should develop a sufficient hardness to require slight re-heating to produce the proper physical properties.

By the use of vanadium a steel has been developed with this hardening power, and this is the basis of the production of a type known as carbon vanadium. In heavy sections, such as large side rods, this steel will show, after normalising, approximately 100,000 lb. ultimate with 60,000 lb. elastic, and elongation about 25 per cent. longitudinal and 20 per cent. transverse, reduction of about 50 per cent. in longitudinal and 30 per cent transverse. Such properties are developed at 200 Brinell, which is a desirable hardness for machining.

Some Notes on Failure in Metals

By Alwyn Pickles, M.Sc.

THERE are many factors that may cause failure in a metal or an alloy. Some of these are understood and may be guarded against, but there are others not completely understood, and a brief consideration of these may be useful.

Faults may begin with the preparation of the metal, for the mixing may be incomplete, impurities may enter, and there may be uneven cooling which causes cracks and fissures to appear. Molten metals are also capable of dissolving gases often to an appreciable extent, these gases being given off when the metal cools, but it is quite possible for the metal to trap some of the gas which becomes imprisoned under pressure, and may thus have a decided corrosive effect on the walls of the cavity, with consequent weakening of the metal itself.

In the investigation of failures in metals it is occasionally possible to use chemical analysis methods, but this is only of value in specific cases, where the relationship between composition and property is well known. It is a method which is obviously of little value in the investigation of metal failures, where a standard of comparison is absent. Etching methods using copper salts, picric acid, etc., may sometimes be of value, and the presence of sulphur may be shown by treating the metal surface with dilute acid and then placing bromide paper on the wetted surface. The sulphuretted hydrogen liberated, if sulphur is present, is shown by the characteristic yellow sulphur tones on the paper.

Metals under Strain

To understand fully the behaviour of a metal under strain it is now recognised that an intimate knowledge of atomic structure is very desirable. It is not only necessary to know what are the component atoms in a metal or alloy, but to know the arrangement of those atoms with respect to one another. Another aspect of the question, which does not seem to have been given its due emphasis in a study of this problem, is that the atom even of a metal in the solid state can scarcely be considered as entirely static. Every atom, at ordinary temperatures at any rate, is full of energy owing to the rapid movement of the electrons of which it is made. Also, atoms do not touch one another in the usually accepted sense of the word, but are held in position by forces which are probably electrical in nature. In any case, the atoms of a solid may be imagined to have a slight degree of freedom which is possibly shown by an oscillatory movement, the amplitude being increased by temperature increase and very possibly by sudden and large impressed forces.

Metallurgists now recognise that all metals are essentially crystalline in their structure. In some cases this crystalline nature may be seen by the naked eye as in the case of zinc or tin; in others special surface preparation of the metal is necessary, and in others the microscope is needed. But in all cases the X-rays have proved of most value. The wave length of X-rays is of the order of atomic diameters, and their use has shown that the crystals of such metals as gold, silver, copper, platinum, and aluminium are cubic in form, each crystal being a cube with atoms at each corner and at the geometric centre of each face of the cube. The inter-atomic forces are thus well balanced, and so we find these metals to be highly malleable and ductile. But it must not be assumed that metals always crystallise in a regular and well-defined arrangement. Rather do they settle out in groups of varying size, and their borders may not be well defined. The behaviour of graphite crystals under oblique pressure is very instructive for the understanding of the behaviour of harder materials. Graphite is used as a lubricant; blackleaded articles, whether iron or the hearth tiles, are slippery, and this slipperiness is no doubt due to the gliding of one plane of atoms over the one beneath. The question of these slip-planes is of great importance in metallurgy, and much work, both theoretical and practical, has been spent in their study. In the case of many alloys whose characteristic hardness, the alloying material—carbon in the case of steel—has not displaced the atoms of iron, but carbon atoms have taken up positions which are not necessarily symmetrical. One plane of atoms is no longer free to slide over the other. The carbon atoms have jammed the sliding planes.

"Fatigue" in Metals

Metals and alloys which are capable of withstanding very large strains are ultimately broken by a succession of small forces. A simple analogy, which may be a true one up to a point, is the possibility of breaking down a strong bridge under the repeated and regular but small stresses and strains caused by the marching of a large body of men. This breaking down of a metal is usually termed "fatigue," and the cause has been the subject of many theories.

The chief points of the more acceptable theories of fatigue appear to be:—

(1) The metallic crystals cannot all be assumed perfect, and there must be regions of discontinuity, though these regions may be very small.

(2) During strain, every part of the metal is not equally affected, and these inequalities will no doubt set up internal stresses not only during the time of strain but also when the strain is removed.

(3) Sudden strain may break up the space arrangement of the atoms in the crystal and, if the strain is severe, a change from the stable to the unstable form of the metal may take place, though the amount of this change may be but slight. In other words, the crystalline may become amorphous by passing through a stage of temporary mobility. This idea is not an impossible one, for the process of metal polishing proves that such a mobile state does exist.

(4) Failure of a metal is by sliding. In the opinion of Beilby, this gliding action causes the change of phase, crystalline to amorphous. More recently, Haigh has expressed the opinion that phase change comes first and then the glide. In either case the change is bound to be accompanied by great internal stresses.

A consideration of the above points will show that ideas as to failure and fatigue of metals are not lacking, though up to the present no one theory sufficiently explains all cases. The conception of "slip-planes" has much to support it, for it is significant that metals never break along the crystal boundaries at ordinary temperatures. The cohesion between the crystals is evidently greater than between the crystal planes. Another peculiar fact about metals, and one that a comprehensive theory will have to explain, is that metals are never so strong as they should be according to calculation. It may also be advantageous to consider the atoms of metallic crystals as not being wholly static.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Institute of Metals Meeting

THE Institute of Metals annual general meeting was well attended, and indeed the Institute may certainly be regarded as a very live body with a very creditable record of activity during the seventeen years it has been in being. The increase in membership recorded in the report of Council indicates a very healthy state of affairs, and as the non-ferrous metal industry was, years ago, perhaps one of the most old-fashioned, conservative and empiric of crafts, the good work the Institute has done in stimulating research and infusing a more scientific spirit into its undertakings can hardly be too generally recognised and acknowledged. It is admittedly difficult to get really good practical papers from good practical men for reading before these technical societies, and equally difficult to avoid a preponderance of more or less academic papers, of limited interest and of little apparent immediate applicability. It has, however, always to be borne in mind that what is academical to-day may become common-place practice to-morrow, and that it is necessary therefore to be patient of results accordingly. This is both an excuse for and a justification of a fair proportion of the papers presented at technical meetings, of which those read before the Institute of Metals, if of no very striking interest and importance, represent, nevertheless, useful work in directions likely to lead to useful results. Amongst the more practical of these papers were an investigation of surface abrasion as a potential cause of localised corrosion, by Mr. Ulick Evans; an account of some comparative tests on some varieties of commercial copper rod, by Mr. T. G. Bamford, and the description of a method of improving the properties of aluminium castings, by Mr. S. L. Archbutt, of the National Physical Laboratory. Of the more theoretical papers, the one possessing most interest was a communication from the Research Department, Woolwich, under the names of Mr. G. L. Bailey and Mr. R. Genders.

Influence of Abrasion on Corrosion

As Mr. Evans points out, the physical character of a corrosion product may be such that it interferes with the continuance of corrosion. This protective influence will naturally cease if the corrosion product be removed. Sometimes the resumed process of corrosion is neither more nor less active at such places than it was before; at other times it is decidedly more active. The subject is intimately connected with the question of the effect of local abrasion on corrosive action, and a number of experiments are described in the paper in which the various factors were varied and the results noted and compared. It is, of course, well known that stressed material possesses a different corrosion factor to unstressed material of the same kind, and, although no reference is made to such work as has been done in this direction, it is evident that much the same factors are involved. Mr. Evans finds that the corrosion product may be cathodic when it is loose and flocculent, or anodic when it is thin and highly protective. Unless, however, mechanical erosion of the metal has occurred, corrosion will only be more or less subsidiary. He describes his conclusions as a compromise between corrosionist and erosionist views. It is not easy to see how the views set forth can be regarded even as a compromise. They are inconclusive, and while the facts recorded are interesting they are not exactly new, and do not appear to lead very far. The whole subject is, however, highly interesting, and is, moreover, one in which chemical engineers are acutely interested. Researches on the behaviour of the so-called corrosion-resisting metals, such as high silicon iron, and alloys like "tantiron" under different conditions of heat treatment, surface tension and stress, might lead to very valuable results.

Sound Aluminium Castings

MR. ARCHBUTT has some very tangible advice to offer. His paper describes work carried out at the National Physical Laboratory for the Engineering Research Board of the Department of Scientific and Industrial Research. Much of the dissolved gases present in molten aluminium, and productive, in the subsequent castings, of unsoundness and pinholing, can be eliminated by a process of remelting. The molten metal, or, in some instances, its alloys, is allowed to cool slowly in the crucible in the furnace, until it has just completely solidified. It is then remelted, and may be carefully stirred, raised to the pouring temperature, and cast. Ingoting the metal is not satisfactory as the ingots cool too quickly, and during remelting are too much exposed to the furnace gases. An experiment in a totally different direction is recorded. It was suggested by Dr. Rosenhain that the removal of small bubbles of gas liberated and entangled in molten metal or alloy might be facilitated by passing an inert gas through the melt. Nitrogen was used, and the resulting bars were found to be remarkably sound and free from pin holes. Double melting would certainly be costly in practice, and the passage of an inert gas difficult and expensive. The production of unsound bars is also expensive; a batch of rejected castings would be more expensive still. Such papers exemplify the very real value of the work of the National Physical Laboratory, for they preserve the essentially scientific sense of balance between what in other research laboratories are apt to be mere test-tube experiments, with no conceivable relation to practical technology, and work of immediate and suggestive utility. There are cases when the absolute soundness of an aluminium casting outweighs every consideration of cost. The work of the Laboratory is always well done. The staff pull together loyally, and their work is directed, particularly in the Departments of Metallurgy, by a man who has a very adequate and well-proportioned sense of what, in a scientific investigation, is germane to the ultimate object, the improvement of industrial processes, as distinct from mere window dressing. The Research Department of Woolwich Arsenal is likewise an admirably directed institution, and some of our Universities might do worse than copy the examples set them by Dr. Rosenhain and Dr. Moore respectively.

High Power Magnification

THE abstract of a paper by Mr. R. G. Guthrie, published in the January number of the *Transactions of the American Society for Steel Treating*, on "High Power Magnification in Metallography," is, technically, of great interest. One of the illustrations which accompanies it shows lamellar pearlite in an abnormal carbon steel, the "abnormality" in this instance being the presence of the cementite in a ferrite matrix from which a practically complete divorce of the pearlite has been accomplished. The magnification is 12,500 diameters taken with a 2-millimetre oil-immersion 1.40 N.A. objective and a 25 X periplan eye-piece. Quite apart from the detail shown, given in good faith and to be accepted in the same way, seeing that the conditions under which the photomicrograph was obtained and the technical data necessary, are given very fully, such an example raises, in an acute form, the question of practical utility. What are the limits to which microscopic magnification is physically possible? What are the limits at which maximum magnifications cease to reveal useful detail? Can anything be seen or deduced at such powers that cannot be seen or deduced at lower and more easily attainable magnifications? It is necessary to discriminate, in this connection, between what is actually seen, in the sense of being resolved, and what is only deducible. The highest degrees of "magnification" hitherto attained by, for example, the ultra-microscope do not resolve; they only serve, to use the language of philosophy, to reveal the existence of particles which otherwise transcend the means at our disposal for their actual resolution. The high powers described by Mr. Guthrie are, be it understood, obtained by single projection, and are not "enlargements," to which, of course, no theoretical limits exist. In what follows this distinction is to be clearly borne in mind.

"Enlargement" versus "Magnification"

IN a certain sense, any magnification is an enlargement; it is the enlargement, by a suitably disposed lens or lenses, of a virtual image already projected in an enlarged form by another. As long as this process is conducted within the instrument of observation, such enlargements, be they telescopic or microscopic, are, by common accord, known as magnifications and viewed, in the instrument, directly as such. The images can, of course, be "projected," thrown on a screen, or on a photographic plate which acts as such a

screen, and enlarged indefinitely up to the limit of visibility imposed by the illuminating effect of the dispersed and attenuated light rays, in accordance with the familiar laws of inverse squares. In all such devices the resolution of the projected image suffers ; it is at its maximum as viewed by the eye applied to the original image. Certain details may, however, be more perfectly perceived, not because they are more perfectly resolved, but because, being enlarged, they are better differentiated, and therefore more noticeable. Sir Robert Hadfield at a symposium of the Royal Microscopic Society some five years ago showed some reproductions of photomicrographs at 8,000 diameters and these purported to be direct magnifications. From the accompanying text, however, it would appear that " extra camera extension " was adopted, which suggests enlargement. In any case, from a variety of reasons, not the least of which is the infinitesimal size of the field, it was pretty generally conceded that, for all practical purposes, 750 diameters was the limit of usefulness in practical applied metallography. For purely scientific research on fundamental principles, the half-wave length of the shortest visible light rays (ultra-violet rays notwithstanding) assigns, with such glass as is at present procurable, the limit to magnification, and this, of course, is far higher either than Sir Robert Hadfield's photographs or those of Mr. Guthrie. But for enlargements there can be very little use, except for lecture purposes with a magic lantern. It remains to be seen if magnifications of 12,500 are of any real use to the engineer or to the metallurgist, and the subject is well worthy of further discussion.

Pin Holes in Aluminium Alloys

THE value of density determinations as a means to gauge the reliability of castings does not seem to have been fully appreciated by foundry metallurgists. Desultory references to the specific gravity of alloys and the dependence of specific gravity upon many variable factors concerning the preparation of the specimen are to be found scattered through metallurgical literature. Very few definite attempts have been made to correlate specific gravity with " soundness," which is the property generally accepted as the most elusive and, at the same time, most essential in a good casting.

Attention has just been drawn to this question by two interesting papers presented at the annual general meeting of the Institute of Metals. The first paper, which was a communication from the National Physical Laboratory, presented by S. L. Archbutt, dealt with the elimination of " pin holes " from aluminium alloy castings. The effect of the type of unsoundness here studied was familiar to all aluminium alloy founders. Castings were found honeycombed, often right to the centre, with tiny holes which make the castings brittle, weak, and porous. They failed to give the specified test figures and when subject to a hydraulic pressure test were shown to be hopelessly unsound. The authors of the paper had chosen specific gravity determinations to measure the extent of the pin-holing, and one must agree that a more direct and at the same time more fundamental test would be difficult to choose. In commercial practice, however, where fear of this defect was seldom absent, specific gravity determinations were only rarely carried out. Ordinary sand castings of " Y " alloy showing marked pin-holing had a specific gravity of about 2·70. Sound castings of the same alloy were made with a specific gravity as high as 2·79. The mechanical strength, as measured by the tensile test, of the alloys with the low specific gravity was very inferior to those with the high specific gravity.

Cavities in Brasses

The second paper on the specific gravity of alloys was presented by G. L. Bailey and R. Genders from the Research Department, Woolwich, and dealt with the density and constitution of industrial brasses. It was pointed out that voids, atomic almost in order of magnitude, were often present in brasses as the result of constitutional changes. The presence of these miniature crevasses could be detected by specific gravity determinations and could be controlled by heat treatment. During the discussion of this paper the value of a specific gravity test as a routine test was mentioned. The inclusion of a specific gravity among the routine tests in many works would allow other more elaborate and expensive tests to be carried out less frequently. Such tests would be most useful in aluminium alloy foundries making automobile and aeroplane engine cylinders, in bronze foundries making liners and valves, and in works manufacturing parts to withstand in practice severe hydraulic pressure. Besides the valuable information it yielded, the test had many other advantages to recommend it. It was easy and speedy to perform, no more unusual apparatus than a chemical balance being required. It needed only a small piece of metal, which might be any shape and size convenient to the particular case. Test material could be taken very conveniently from actual castings, and the difficulty of securing representative test figures was thereby minimised.

Routine Density Determinations

If specific gravity tests became generally applied, it would be necessary carefully to guard against a tendency, when interpreting results, to extend the comparison too far and therefrom to deduce conclusions which were not justified by the facts of the case. The specific gravity of an alloy depends upon its mechanical, chemical, and structural composition. Rolling, hammering or other forms of work caused an increase in the density of cast material. Structural changes in the solid, such as the precipitation of a compound from a solid solution, were frequently accompanied by a volume change which, of course, influenced the specific gravity.

It was seldom possible to calculate the specific gravity of an alloy from the proportion and specific gravities of its constituent metals. Simple solid solutions were often formed without any great deviation from the calculated specific gravity, but whenever intermetallic compounds were formed there might be either a great increase or decrease of the specific gravity. These considerations restricted a comparison of the specific gravities to similar alloys similarly treated. A standard specific gravity would have to be determined, either from a lightly worked and annealed sample, from a specially chosen sound casting, or from fine filings or other form of powdered metal. Any of those methods would give a datum figure against which the results of routine determinations on everyday work could be compared. Any serious divergence would then call for special investigation. In this way, unsoundness would be quickly detected without the expense incurred by an elaborate system.

Germany's Iron Industry

THE Commercial Secretary at Berlin, in his February report, states that the formation of associations in the rolled iron industry made no progress in February, although the efforts to form associations for finished products were continued. The weakening of prices which was observable in individual instances on the scrap iron market towards the end of January developed into a general downward movement. The fall in scrap prices was primarily due to the fact that the works held back with purchases after they had covered their main requirements. Funds did not admit of the works laying in too large stocks of scrap. Pig iron sold well. The Pig Iron Association was able, as from February 16, to raise the prices for the best marketable sorts by 2 marks per ton. On the rolled iron market the activity which prevailed at the end of January was succeeded by somewhat quieter conditions. At present fairly uniform prices obtain on the rolled iron market and are being maintained by the leading works. The works' stock of orders has probably not declined, and should be sufficient to ensure adequate employment for some time ahead. In some works individual manufacturers have ordered in such large quantities that difficulty is experienced in delivering the goods within a reasonable period. Towards the end of February new orders again began to come in. The decision of the Raw Steel Association that the production of the works is to be restricted in March by 15 per cent., against the average of 10 per cent. in the past four months, afforded a further inducement to place new orders. The foreign market was irregular. Prices were subject to small fluctuations, but have, on the whole, altered but little. They must be described as exceedingly low.

Aluminium Repairs

Barimar, Ltd., of 14–18, Lamb's Conduit Street, London, W.C.1, have issued a booklet which deals with the company's metallurgical process for repairing aluminium parts. Damaged castings can be strengthened by this process in order to avoid the risk of further breakages.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

We have now seen the close of the first quarter of the year and with it the abandonment of any hopes of a trade revival for the present. The month of March has not belied the prospects with which it opened. It has followed on the same course as the previous month, but with even less life in it. Some makers have been fortunate enough to secure sufficient orders to keep them steadily at work; others are finding that new work is not coming in so fast as the orders on the books are being worked off; while in some quarters we hear the sorry story of works or departments being closed down. Messrs. Alfred Hickman and Co. have this month closed down two mills and discharged 700 men for lack of orders. The Steel Co. of Scotland have closed down their Hallside Works for a similar reason. There is a rumour that another of the largest works in the country is about to close down one of its plants, a rumour that may be well founded, as this particular works is at present operating only a small part of its capacity. In the Middlesbrough district conditions are heart-breaking. There are only about half the blast furnaces working, and some of these may at any moment be stopped. Indeed, notice has just been given that three more are to be blown out.

An Anxious Outlook

Really one wonders what is to be the outcome of it all. The depression seems to be as bad as at any time during the last two or three years and one cannot point to any direction along which relief is to come. It is no use going over again the various causes and the suggested remedies. We know too well that productions costs are higher than they ought to be, that coal and transport are much too dear. The whole thing centres round the hours of work and wages, but the attitude of the trades unions to this matter is as stubborn as ever it was, and we are not hopeful of any change until it is forced by sheer necessity, as it was in Germany. The result of the overthrow of the Labour Government has not been to bring more reason into their outlook, but rather to increase their obstinacy, and it is hard to avoid the conclusion that they are less willing than ever to help the manufacturers to find a way out of the present depression.

Shipbuilding Orders

Much comment has been aroused by the placing of the order for ships with the Deutsche Werft, and various attempts have been made to explain the how and why of it. It has been authoritatively stated that the German shipbuilders were enabled to underquote the British by reason of a subsidy granted by the German Government out of the unemployment fund. This has been denied, but we are not convinced. It is a far more sensible thing to pay money to the employers to enable them to find work for the men than to pay the money to the men for being out of work. Whether the subsidy story is true or not, there is no doubt that the lower wages and longer working hours in the German yards, together with the close co-operation between the steel makers and the shipbuilders have largely assisted the German firm to secure the contract.

As a contrast to this it is pleasing to hear that two of the Tyneside shipbuilding firms, Messrs. Palmers and Messrs. Hawthorn, Leslie and Co., have secured orders for four tank vessels, involving an expenditure of about £850,000, for the Anglo-Saxon Oil Co. Two smaller vessels have been placed on the Continent at lower prices. Patriotic reasons are stated to account for the Tyneside orders.

Safeguarding Hopes

There are still hopes of relief being obtained for the iron and steel trades under the Safeguarding of Industries Act. It is not going to be easy to frame a case for protection under that Act, as there are so many conflicting interests in the trade. It is no secret that many of the large steel making firms in England and Scotland are buying large quantities of continental steel and rolling it down. The re-rollers have been doing this extensively for a considerable time, but it is rather disturbing to find the steel makers having to adopt the same practice. The advantage to the steel makers is not so great as appears at first sight, as the margin between the foreign price and the home cost is considerably reduced by the risks as to quality and the conditions attached to the purchase. Fortunately, there is still a considerable market for which British steel only will be accepted.

There is some satisfaction to be derived from the announcement that the order for the two Australian cruisers has been placed with Messrs. John Brown and Co., of Clydebank. The actual building of the vessels will be done at Clydebank, but the heavy forgings will be made in Sheffield, consequently both districts will receive a much needed stimulus. Messrs. Vickers have also secured an order for two submarines, which will benefit both Barrow and Sheffield.

Market Conditions

The market reports for the month are not pleasant reading. Pig iron has weakened further, prices having fallen approximately 5s. per ton, without inducing any appreciable amount of buying. The weakness of the market is reflected in the price of coke. A reduction of 1s. per ton for the next three months has been agreed upon by the ironmasters and the coke makers, but coke is being freely sold at more than 1s. per ton below the price taken in the previous quarter. Indeed, coke is rather a drug on the market; the export trade is poor and the demand from the home furnaces has decreased. It needs much more than a reduction of 1s. in coke to balance the reduction in the price obtainable for pig iron. There has recently been a little better movement in Cleveland, probably due to the renewal of expiring contracts. The hematite market is also very unsatisfactory. Production continues to exceed demand, the result being a gradual falling of prices or the blowing out of furnaces.

The iron trade in Lancashire and the Midlands shows no development. The best that can be said about it is that prices remain steady, but actual business is slow. It is useless for the crown iron and bolt makers to expect any improvement so long as the Belgian and French works can send iron into this country at prices £3 to £4 per ton below ours. At present marked bars do not suffer from this competition, but there is always the possibility of the continental makers obtaining a footing in this market.

The Steel Trade

The steel trade offers no relief from the gloomy picture. Orders are scarce and are therefore subject to keen competition. The price of billets is easier and orders are falling off. The competition of foreign billets is being increasingly felt. Acid billets are a little better than basic, but they are not too bright. Plates and sections are about the worst feature. The basic price of plates remains nominally at £9 15s., but orders of any magnitude are comparatively rare, even when the price is shaded, as it is by some of the makers. Sections are selling at £8 12s. 6d. to £8 15s., and even £8 10s. is being accepted by some makers. Steel bars, which have been one of the strongest features, are inclined to weaken, and it is only the special trades, where good reliable quality is demanded, that prevent this market from sagging further. We know of one order for 1,000 tons which has just been placed by a Midlands firm with a continental maker for bars to guaranteed tests at £6 19s. 6d. and £7 2s. 6d. per ton delivered.

There has been a good deal of talk, particularly in the Lancashire district, about the action of one English merchant who has been busily engaged in bearing the market in pig iron and steel of all kinds, and actually booking contracts at prices below the ruling quotations of the makers. This firm are evidently operating on the correctness of their forecast of the future trend of the market, but such a policy only accentuates the prevailing depression.

The scrap trade is particularly quiet at the moment. With so many of the steel furnaces standing idle the demand for scrap has fallen off very greatly, and merchants are finding difficulty in disposing of their purchases. The price has fallen more than 10s. per ton since the beginning of the year and supplies can now be bought at little over 70s. per ton. Coal prices are also falling owing to the decreased demand. Reductions of 1s. to 2s. per ton can be obtained for renewal of contracts, and spot lots of good coal can be bought at ridiculous

prices. All these reductions are a great help to the steel maker in meeting the competition for orders.

The output of pig iron in February amounted to 534,100 tons, compared with 574,500 tons in January. The number of furnaces in blast at the end of the month was 164, or 8 less than at the beginning. The output of steel ingots and castings was 646,400 tons, as against 605,100 tons in January.

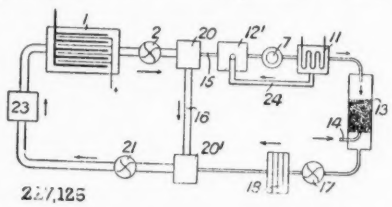
Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Copper and Tin Compounds

A PROCESS for obtaining copper and tin from bronze by electrolytic deposition is the subject of a patent application by O. Scarpa, of Turin, Italy. The copper is deposited in a copper sulphate bath, and the spent electrolyte containing tin is transferred by a pump 2 to a vessel 20. Part of the liquid passes to a tank 12[1] where it is heated to boiling-point and diluted. Precipitated matter is removed in a centrifuge 7, and the liquid passes on to an evaporator 11 and tower 13.



227,125

In the tower the free acid is neutralised by copper scrap and hot air and steam are injected. The liquid then passes through a pump 17 and filter 18 to a tank 20[1], where it is mixed with the remainder of the spent electrolyte from the tank 20. The liquor is then returned by a pump 21 to the electrolyser 1, sodium salts being added and the copper content adjusted in the tank 23. Electrolysis is affected at 20°–60° C. See Patent Application 227,125, having the International Convention date, January 5, 1924.

Reducing Ores

A PATENT application has been made by H. G. Flodin of Roslags-Näsby, Sweden, and E. G. T. Gustafsson of Stockholm for a process of reducing ores in an electric furnace. The ore is finely divided, mixed with carbonaceous material and binder, dried or hardened, and then reduced. If the reducing material is a liquid, *e.g.*, tar, oil, asphalt, etc., the mixture is dried in air at 100°–250° C. If the ore contains sulphur, lime, or other alkaline earth oxides may be added before mixing. If quartz, manganiferous ores, chrome, vanadium ores, etc., are added to the charge, alloy iron or steel may be produced. The metal may be refined subsequently by adding ferro-silicon, ferro-manganese, silicious aluminium iron, or aluminium, and heating again. If the phosphorus content is high, a basic slag rich in lime may be added to obtain a slag rich in phosphorus which may be used as a fertiliser. See Patent Application 227,435, having the International Convention date, January 12, 1924.

Cementation of Iron

IN a process for the carbonisation or cementation of iron or iron alloys by methane, for which a patent application is made by Gelsenkirchener Bergwerks Akt.-Ges. Abteilung Schalke, of Gelsenkirchen, Germany, certain limits are imposed on the percentage of hydrogen. In an example, when iron is treated at atmospheric pressure and at a temperature of 300° C., the hydrogen content should be below 1·7 per cent., at a temperature of 445° C., below 3·4 per cent., and at a temperature of 508° C., below 8 per cent. The proportion increases with the temperature, and also with reduction of pressure. See Patent Application 228,099, having the International Convention date, January 24, 1924.

Recovering Tin

ACCORDING to a patent application by F. Wüst, of Düsseldorf, Germany, an iron-tin alloy is fused and treated with silicon or ferro-silicon to obtain a layer of tin, and a separate layer of alloy containing iron and silicon. See Patent Application 228,103, having the International Convention date, January 22, 1924.

Alloys

AN application for a patent for a light alloy has been made by Soc. Anon. Nieuport-Astra, of Issy-les-Moulineaux, France. An alloy of copper 54·5 per cent., nickel 16·5 per cent., and zinc 29 per cent. is first made and deoxidised by means of baryta. 100 kg. of molten aluminium are then added to 6·5 kg. of the above alloy, and then 500 grams of magnesium. The mixture is treated with 2 kg. of caustic soda, and cast at about 700° C., heated to 530° C. for 1½ hours, cooled in water, and then heated in boiling water. See Patent Application 228,143, having the International Convention date, January 23, 1924.

An alloy which is not affected by damp, climatic conditions, or weak acids has been patented by H. O. Ormiston, of London. A "stock" is first formed of copper 97 parts, titanium 3 parts, and cobalt 2 parts. The final alloy consists of nickel 50 parts, copper 20 parts, zinc 12 parts, silicon copper 1 part, "stock" 1 to 20 parts. The mixture is melted at 1600° C. See Patent 229,839, dated January 30, 1924.

French Sales in Germany

IN spite of the Customs barrier, the French works are making every effort to continue to sell their products in Germany. This effort is felt mostly in the case of the delivery of half-products to the Siegerland. The prices of the Lorraine works for half-products delivered free at Siegen, inclusive of duty, are not higher than the guiding prices fixed by members of the Half-Products Association. These guiding prices may, however, be regarded as the lowest which are demanded by German works for half-products. The Lorraine prices are, therefore, really below the average German prices. Furthermore, according to the latest reports, the French Government is even proposing to grant a special premium of 25 francs per ton for half-products. The supply of Swedish ores in the month under review was adequate. The high French and German railway freights continued to make the import of minette difficult.

The position of the metal industry remained unchanged. Important orders were received by the metal half-products industry, and good employment appears to be ensured for the majority of the works for the next few weeks. Prices, however, still leave much to be desired. Inquiries in the machinery industry showed an improving tendency in the last week of February. The position is, however, described as uncertain, and it is doubted whether the favourable business will continue. Though raw materials and half-products have advanced somewhat in price, the occurrences on the scrap iron market have probably accentuated the uncertainty in regard to the future. The little confidence shown in the next few months is all the more remarkable as the influx of orders was, in general, comparatively lively.

A Non-corrosive Alloy

AN alloy of copper and silicon, known as "Everdur," was originally developed by the DuPont Engineering Co., Wilmington, Del., to meet the corrosion problems arising in connection with the use of hydrochloric acid, but it has been found to be resistant to a large number of other corroding agents. It has been in use in the DuPont Plant for several years under conditions where corrosion is caused by sulphuric acid, aluminium sulphate, chlorine solutions, fruit juices, lactic and citric acids, the salts of several of the metals, nitric, carbolic and oxalic acids, and caustic soda, accoridng to a New York correspondent of *The Times*. The metal is golden in colour and will take a high polish. The cost is comparable with that of high-quality bronzes. Early in its history the alloy was discovered to be workable by most of the standard methods. It possesses a high tensile strength and elastic limit. The yield-point has a value of 56,000 lb. per sq. in. The alloy machines readily, makes excellent castings and drop forgings, rolls and draws hot or cold, can be welded, brazed, or soldered, and is easily brought to any desired temper by annealing. Some of the forms in which it has been used are drop forgings, sheets, rods, wire, and pipe fittings, castings, bolts, nuts, screws, chains, and nails.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Engineering requirements of alloys for use at high temperatures. R. W. Bailey. *Bull. Brit. N.-F. Metals Res. Assoc.*, March, 1925, pp. 8–14.

The three-phase system molybdenum-nickel-silicon. Dr. Pfautsch. *Z. Metallkunde*, February, 1925, pp. 48–52 (in German).

The three-phase system chromium-nickel-molybdenum. E. Siedschlag. *Z. Metallkunde*, February, 1925, pp. 53–56 (in German).

ANALYSIS.—Some notes on the subject of the analysis of cast iron. G. Batta. *Chim. et Ind.*, February, 1925, pp. 195–198 (in French).

Separation of nickel and iron from chromium by electrolysis. E. Rousseau. *Chim. et Ind.*, February, 1925, pp. 199–201 (in French).

Electrometric titrations, with special reference to the use of titanous chloride for ore analysis. A. McMillan and W. C. Ferguson. *J.S.C.I.*, March 27, 1925, pp. 141–142T.

CORROSION.—Causes and controlling factors in the corrosion of iron and steel. W. P. Wood. *Trans. Amer. Soc. Steel Treating*, March, 1925, pp. 321–336. Compares the acid and electrolytic theories, discusses the effects and importance of the controlling factors and reviews the work on the effect of light on corrosion.

ELECTRO-DEPOSITION.—Studies on electro-plating (*continued*). W. E. Hughes. *Metal Ind.* (*Lond.*), March 13, 1925, pp. 257–260 and March 27, 1925, pp. 313–317. Discusses the advantages, mode of action, and effect on the structure of electro-deposits of agitating the plating solution.

GENERAL.—The practical importance of the equilibrium diagram. D. Hanson. *Metallurgist*, February 27, 1925, pp. 18–22.

Sample preparation for high power photomicrography. R. G. Guthrie. *Trans. Amer. Soc. Steel Treating*, March, 1925, pp. 337–362. Description of the polishing and etching of specimens; some photomicrographs are included.

GOLD AND SILVER.—Cyanidation of gold and silver ores of Northern Ontario. C. Spearman. *Canad. Chem. Met.*, March, 1925, pp. 55–59. A review of the development of present methods, with information as to the solution of special difficulties.

IRON AND STEEL.—The chemistry of iron and steel. Part II. F. T. Sisco. *Trans. Amer. Soc. Steel Treating*, March, 1925, pp. 363–378. A discussion of the chemical reactions taking place in the blast furnace.

Facts and principles concerning steel and heat treatment. H. B. Knowlton. *Trans. Amer. Soc. Steel Treating*, March, 1925, pp. 379–405. A description of the tensile, impact and hardness tests for wrought iron, cast iron and steel; the hardening of steels and the changes taking place during heating are also discussed.

The iron-carbon diagram and the most important structure constituents of carbon steels. K. Daeves. *Stahl u. Eisen*, March 19, 1925, pp. 427–434 (in German). An illustrated discussion of the diagram and its interpretation.

The improving of cast iron by alloying additions. E. Piwowarsky. *Stahl u. Eisen*, February 26, 1925, pp. 289–297 (in German). Systematic investigation of the change in properties produced by the addition of a number of special elements.

Recent developments in case hardening. A. R. Page. *Metal Ind.* (*Lond.*), March 20, 1925, pp. 297–299 and March 27, 1925, pp. 321–323. Deals in particular with carburising pots and furnaces, steels for case-hardening, carburising temperature and materials, and the mechanism of cementation.

TIN.—Electrolytic detinning. *Chem.-Zeit*, February 5, 1925, pp. 117–119 (in German). A detailed description of the process.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of* 1908 *provides that every Mortgage or Charge, as described therein, shall be registered within* 21 *days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

BRITISH ALLOYS CO., LTD., Clayton West.—Registered February 26, £2,000 debentures part of £20,000; general charge. *£16,000. December 31, 1924.

BRITISH METALS EXTRACTION CO., LTD., London, S.W.—Registered February 24, £2,000 6th debentures, to Hon. G. W. P. Winn, 31, Montague Square, W., and others; general charge (except patents, etc.). *£65,451 18s. 7d. January 2, 1925.

BRITISH METAL (KINGSTON), LTD.—Registered March 11, £3,500 mortgage, to Mrs. G. L. and E. J. Woolnough, 17, Ceres Road, Kingston-on-Thames, and Westminster Bank, Ltd.; charged on properties at Kingston-on-Thames. *£20,000. December 31, 1924.

CAMBRIAN ELECTROLYTIC ZINC CO., LTD., London, E.C.—Registered March 6, £4,000 £2,000 and £1,000 debentures part of £10,000; general charge. *£10,000 debentures. October 9, 1924.

DAVY BROTHERS, LTD., Sheffield, ironfounders.—Registered March 10, mortgage by way of collateral security (supplemental to mortgage for £6,400 dated September 29, 1893), to W. B. Esam, Sheffield, solicitor, and others; charged on Park Iron Works, Sheffield. *£36,400. July 14, 1924.

DUNDERLAND IRON ORE CO., LTD., London, E.C.—Registered March 3, two Trust Deeds dated February 25 and February 26, 1925, securing £100,000 1st debenture stock and £125,000 income debenture stock (ranking next after 1st debenture stock); charged on company's properties, etc., in Norway, also general charge. *£250,000. November 4, 1924.

NORTH BRITISH ALUMINIUM CO., LTD., London, E.C.—Registered February 23, Trust Deed dated February 17, 1925, securing £2,500,000 guaranteed debenture stock; general charge.

SMITH AND COVENTRY, LTD., Salford, ironfounders.—Registered March 9, further charge securing £1,750 and further advances up to £10,000 (created by the receiver), to Norwich Union Life Insurance Society, Norwich; charged on property, comprised in 1st and 2nd debenture Trust Deeds. *£115,000. October 31, 1923.

TYNDRUM LEAD AND ZINC MINES, LTD., London, E.C.—Registered February 19, £327 A debentures part of £35,000; general charge. *£35,976. January 14, 1925.

WING (MICHAEL AND JOSEPH), LTD., Sheffield, steel manufacturers.—Registered Pebruary 19, £11,000 (not ex.) charge, to John Wood and Sons (Wisewood), Ltd., Wisewood Rolling Mills, Sheffield; charged on Jericho Works, Holme Lane, Hillsborough. *Nil. April 26, 1923.

Satisfaction

BOLCKOW, VAUGHAN AND CO., LTD., Middlesbrough, ironmasters.—Satisfaction registered February 27, £357,636 12s., part of amount registered September 9, 1924.

The Institute of Metals

ON April 22 there will take place an election of new members and students of the Institute of Metals, particulars of which may be obtained from the Secretary, Mr. G. Shaw Scott, 36, Victoria Street, London, S.W.1. The subscriptions of persons then elected will cover not merely the usual period of twelve months but also the extended period ending June 30, 1926. The election is arranged in connection with the 15th annual May Lecture, which is to be given by Professor H. A. Lorentz, of Leiden, Holland, on May 6, tickets for which may also be obtained from Mr. Shaw Scott. The subject of the lecture is "The Motion of Electricity in Metals."

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

Some Uses and Properties of Mercury

By G. Malcolm Dyson, B.Sc., Ph.D.

MERCURY, known to the ancients as quicksilver, is one of the metals that occur free in nature, although the quantity of such uncombined metal is not sufficient to pay for its commercial extraction. The principal source of the mercury of commerce is the ore cinnabar, which is mercuric sulphide, HgS.

Extraction of the Metal

The earlier methods for the extraction of this metal consisted in roasting the ore in a shaft or muffle-furnace, thereby oxidising the sulphur to sulphur dioxide, and setting the mercury free. The mixed vapours were then passed through a long series of earthenware pipes, known as "aludels," in which the mercury was condensed. Such processes are extremely wasteful, and in some factories as much as 50 per cent. of the available mercury escapes extraction—partly as residual sulphide in the furnace ash and partly as mercury vapour into the air—facts which make the process particularly undesirable. The newer processes favour roasting with scrap iron on the bed of a reverberatory furnace, in a true shaft furnace, or in a rotary calciner. The sulphur is completely removed as iron sulphide, which, it may be added, has a commercial value, while the vapours are passed through an intricate and complicated series of water-cooled condensers. This process carries with it the advantages, firstly, of an increased yield and a saleable by-product, and, secondly, of being more hygienic and fraught with considerably less danger to the workpeople.

Mercury prepared by any of these processes is highly contaminated with both suspended and dissolved impurities. The suspended matter—dirt and base metal oxides—is removed by filtration through a special cloth, while in some cases chamois leather is used. The dissolved impurities are more difficult to deal with. A comparatively pure metal can be obtained by shaking the impure metal with 5 per cent. nitric acid, or, better, by spraying the metal through an acid of this strength, while an even better method is to suck a strong current of air through the mercury covered with a layer of 5 per cent. nitric acid. The action in all these methods is the same and consists of the oxidation of the base metals by atmospheric oxygen, and solution of the oxide so formed in the nitric acid. At the same time the nitric acid dissolves some of the base metal itself and so aids purification.

Mercury so purified is pure enough for ordinary purposes, but for work such as gas analysis, or with automatic mercury pumps, where the least trace of impurity fouls the surface of the glass apparatus, a purer mercury is required. The only way of getting mercury pure enough for this purpose is by distillation. The mercury is distilled from iron retorts, the surface of the metal being covered with a layer of iron filings to prevent "spitting" and consequent contamination of the distillate. For specially refined work a further distillation from glass vessels *in vacuo* completes the purification.

Uses and Properties of the Element

Pure mercury possesses a silver-white colour. It is liquid at the ordinary temperatures, and the globules retain their spherical shape. The freezing point of the metal is −39° C. and the solid metal is both malleable and ductile, although capable of being cut with a knife. Mercury, in common with the rest of the metallic elements, is transparent when in very thin films, transmitting a violet-blue light. This phenomenon is easily seen when a powerful jet of water is directed on to a mass of mercury. Bubbles of the metal, about a centimetre in diameter, are seen floating on the surface of the water. They are, in reality, thin films of mercury, and are seen to transmit a blue light.

Apart from its commercial uses, mercury has a wide application in the chemical and physical laboratories. In the manipulation of gases it is invaluable—not only as a liquid in which the gases are insoluble, but as a convenient medium for the working of Sprengel, Töpler and other types of mercury pumps, used for the production of high vacua. The high density of the metal and the fact that it does not "wet" glass, combine to increase its usefulness in this respect.

The chief application of the element itself, in commercial practice, is in the extraction of gold and silver from their ores, although in some cases the more efficient chloride and cyanide processes are exclusively used. In the case of gold extraction the finely ground ore from the stamps is mixed to a fluid consistency with water and allowed to flow over the "slime table," a large, sloping copper plate, well amalgamated with mercury. The mercury removes the gold in the form of an amalgam, and after some time the flow of slime is stopped, the table washed, and the amalgam scraped off with rubber pads, filtered through leather, and the gold obtained by distillation—a mass of spongy gold remaining behind in the retort. Such a process has its obvious disadvantages, in that some of the gold must inevitably escape amalgamation, and some amalgam must be detached from the plate and washed away. This waste can be partly eliminated by extracting any residual gold from the "tailings" by the cyanide process.

The extraction of silver by means of mercury is a more laborious and complicated operation—although one which has been constantly in use since it was first introduced into Mexican practice by Bartolomeo de Medina in 1557. The ore is finely ground to a powder, and this mixed with water, the mud being mixed with from three to five per cent. of common salt, which latter is thoroughly incorporated throughout the mass. After standing for a day or so, mercury is added, together with an impure mixture of cupric and ferric salts known as "magistral," and the mixture well stirred (often by the treading of mules) for some 40-50 days—more mercury being added from time to time. When amalgamation is complete, the amalgam is washed in buddles of the usual type and the silver obtained therefrom by distillation. Various modifications of this method have been more or less successfully introduced from time to time, including the American process, in which amalgamation takes place in rotating barrels, and the Boss continuous process in which the cascade method of extraction is used.

Amalgams

Mercury possesses the property of amalgamating with nearly all metals, and the resulting alloy, be it solid or liquid, is known as an amalgam. The amalgams of silver and gold have been mentioned, so that it remains now to discuss the amalgams of the base metals.

Sodium amalgam is obtained by the solution of sodium in mercury, a reaction which takes place with the evolution of much light and heat, and a sound similar to that of quenching steel. The amalgam, which is solid if it contains more than one part of sodium in eighty of mercury, finds use in technical organic chemistry as a reducing agent, whilst in commerce it is met with as an intermediate stage in the preparation of electrolytic caustic soda by certain processes. It is also used

to some extent in the extraction of gold from its ores, to replace pure mercury. Sodium amalgam exists in the form of several definite compounds, the most distinct of which is $NaHg_2$, a silver-white, hard, crystalline substance melting at 360° C. Potassium amalgam is very similar in its properties, and also exists in a series of compounds, that of the highest M.P. being KHg_2, M.P. 270° C.

Magnesium amalgam is of interest in that it decomposes water with a far greater rapidity than the unamalgamated metal, and for this reason is employed as a reducing agent.

Copper amalgam has peculiar mechanical properties which have led to its use in the arts. An amalgam of copper containing from 25–33 per cent. of copper becomes plastic when heated and rubbed at 100° C. After from ten to twelve hours the amalgam loses this plasticity and assumes a granular crystalline structure, and is hard enough to engrave upon tin. Its density is the same in both plastic and hard forms, and thus when hard will exactly fill cavities into which it was pressed while in the plastic condition. It has, for this reason, been used for the stopping of teeth, although its tendency to blacken renders it objectionable for this purpose. It is also used to obtain impressions of engravings.

Tin amalgam can be prepared in large lustrous crystals containing about 48 per cent. of tin, and is used in the preparation of mirrors. For this purpose tin-foil is spread on a perfectly even horizontal bed of slate, and on to this is poured a thin layer of mercury, and a well-cleaned sheet of plate glass floated on to the amalgam. The excess of mercury is removed by pressure and the mirror coating protected from damage by a coat of varnish.

Compounds of Mercury of Industrial Importance

The oxides of mercury are three in number, mercurous oxide, Hg_2O, mercuric oxide, HgO, and mercuric peroxide, HgO_2. The latter is an indefinite substance obtained by the catalytic decomposition of hydrogen peroxide by mercury, but the former give rise to two series of mercurous and mercuric salts, and are quite definitely characterised compounds.

Mercurous oxide can be prepared by the precipitation of a mercurous salt with an excess of an alkaline hydroxide. It is a black powder with a great affinity for oxygen, with which it will combine at as low a temperature as 100° C. Mercuric oxide, HgO, can be prepared by a variety of methods, chief among which is the heating of the nitrate with metallic mercury, when mercuric oxide remains in brick-red tabular crystals. Prepared by the precipitation of a mercuric salt with caustic soda solution it forms a yellow powder, which consists of microscopic crystals. It is probable that the difference between these two forms is merely due to the size of the particles.

Like silver, mercury froms several explosive compounds, chief among which is the fulminate, which is obtained by the action of alcohol on a warm solution of the metal in nitric acid. It occurs in grey crystals, exploding on the slightest impact, a property which makes it valuable for the manufacture of detonators and firing devices of many kinds. There is also a basic perchlorate. $Hg(ClO_4)_2.2HgO$, which is also violently explosive.

Both mercurous and mercuric chlorides are of considerable industrial importance and have been employed medicinally from the earliest times. Mercurous chloride, Hg_2Cl_2—known as "calomel"—is usually prepared by sublimation. For this purpose an intimate mixture of the higher chloride, $HgCl_2$, with mercury is sublimed in cast-iron pots. The sublimed powder is well washed with water to remove any traces of mercuric chloride and so obtained as a yellowish-white powder, which is almost insoluble in water.

Mercuric chloride, $HgCl_2$, is prepared commercially by heating a mixture of equal parts of dry common salt and mercuric sulphate, with a little manganese dioxide, the function of which is to oxidise any remaining traces of mercurous salts. On heating, the whole of the mercuric chloride sublimes in heavy crystalline crusts. The compound possesses a sharp metallic taste and is known as "corrosive sublimate." It is a violent poison and is used externally as a bactericide in antiseptic surgery, and internally in certain diseases of spirochoetal origin. It also finds employment as an anti-putrescent in anatomical preparations and in dressing furs and skins.

The iodides of mercury, HgI and HgI_2, are chiefly of interest for the behaviour of the mercuric compound. When mercuric iodide is heated it changes from its scarlet form to a clear lemon-yellow dimorphic form. On cooling the change to the scarlet form is not spontaneous but can be stimulated by scraping or some other form of mechanical shock.

Mercuric sulphide, cinnabar, is the basis of the pigment vermilion. It occurs naturally in the red form, and the finely levigated mineral can be used as a pigment; but the best vermilion is prepared synthetically. As prepared by the combination of the elements, or by the precipitation of a mercuric salt with hydrogen sulphide, mercuric sulphide is black, and to convert it into the vermilion modification special treatment is necessary. Commercially the substance is prepared by one of the following processes. In the dry (or Dutch) process mercury is added to an excess of fused sulphur, and the cold broken mass brought into earthenware pots, which are heated in a sand bath until the excess of sulphur is driven off. The crucibles are then covered with an iron plate, and the temperature raised until the cinnabar sublimes. In the wet way, mercury and flowers of sulphur are rubbed together until the whole is converted into a brown powder, which is then mixed with 20 per cent. potash and the whole agitated. After eight hours the mass begins to turn red, and when the right colour has been attained the whole is rapidly washed with water, since further action of the potash turns the pigment brown. Vermilion prepared by this process is superior to any prepared in the dry way.

Organo-Mercuric Compounds

The element mercury shows an extraordinary tendency to attach itself to both carbon and nitrogen, by firm linkages, so that the organic compounds of mercury are both numerous and valuable. There are, however, but few of them that have any commercial application. The ammoniacal compounds of mercury include Millon's base, obtained by the action of ammonia on mercuric oxide, and the fusible and infusible white precipitates, which have considerable medicinal value. Among the more complex organo-mercuric compounds the mercury alkyls stand out because of their intensely poisonous action, while at the present time there are being introduced into medical practice a series of dyestuffs containing mercury (e.g., Mercurodin), which are having considerable success in the treatment of syphilis and similar diseases.

Manufacture of Condenser Tubes

From a Correspondent.

THE materials employed in the manufacture of 70/30 brass for condenser tubes are usually of the highest possible quality. No outside scrap is allowed to enter the mixtures and only trimmings from the tubemill, whose composition is of a definite character, are added to the virgin ingots. The copper used is mostly electrolytically refined and shows a copper content of 99·9 per cent. Spelter is generally specified to contain not more than 0·5 per cent. impurities, and in special cases is expected to be well below that figure. Tin is usually of the best standard quality, either "Straits" or "Banca," which are the most expensive on the market, being preferred.

The melting and casting of the billets prior to piercing, etc., is a comparatively simple matter. Pit fires heated by coal are employed to melt the metal, which is charged into ordinary plumbago crucibles. The copper and spelter are weighed out separately and supplied to the melter who melts the copper, and then adds the zinc in the usual manner. The metal for Muntz metal tubes is cast in billets which are about 40 inches long and 2 to 2½ inches in diameter. Brass for four of these billets is poured from the crucible, and the castings or billets are eventually turned off and the ends trimmed back for shrinkage. Before further treatment the billets are thoroughly inspected and weighed. Admiralty and 70/30 tube castings are made in what is known as "cannon" moulds of iron, having destructible cores made of clay and straw over a perforated iron pipe. The dimensions of the tubes or shells made are about 4 feet long, 2⅝ inches inside diameter and 3 11/16 inches outer diameter, thus making the metal approximately ⅝ inches thick.

Making the Tube

The billets are now ready to be made into tubes, the work involving three distinct mechanical processes. Piercing is the first of these processes that is applied to the billet. The

billet is first raised to a cherry red heat and then passed through the piercing machine. In this machine the billet is rapidly rotated between conical rollers, while a mandrel is thrust through the centre of the metal, making it into a tube. When the billets have been formed into rough tubes they are passed on to the second and third stages of operation, which are known as the "breaking down" and "drawing" processes. This work is conducted on chain draw benches for drawing, and on hydraulic draw benches for breaking down. Admiralty and 70/30 brass tubes are put first on the breaking down benches, and finally finished to the desired size by successful drawings on the smaller draw benches.

Heat Treatment

Annealing is conducted in large rectangular furnaces known as annealing stoves. These furnaces are built of fire brick heated with gas or oil and open at both ends. The tubes are passed in at one end and maintained at standard temperatures for fixed periods, after which they are withdrawn at the further end to cool in the air, or to be quenched. The tubes are annealed between each drawing or set of drawings, and after the final drawing. Annealing is required to soften the metal and permit of the next drawing being conducted effectively, and to remove all strains between the molecules of the metal. The final annealing is necessary to give the finished tubes the desired crystalline structure for use as condenser tubes. The toughness, ductility, hardness, resistance to corrosion, and other properties of metals result from suitable heat treatment or annealing. These changes are no more unusual than others with which we are perhaps more familiar, such, for example, as the condensation of steam to water. These physical changes take place without making alteration in the chemical constituents of the substance under treatment.

Cold working of the metal is found to change the crystalline nature, usually making it finer. At one time it was erroneously supposed that when metal was drawn it changed in shape like a piece of putty. By practical experiment it has been demonstrated that when under strain the deformation of metals is accompanied by slipping along gliding surfaces, known as "gliding planes," of the numerous crystals contained in the mass. A reduction in the size of the crystals is also caused, and it is concluded that the increased hardness is due to a fine crystalline structure. Drawing hardens the metal and is accordingly known as strain hardening.

Effects of Annealing

To get satisfactory results, a certain amount of cold drawing is desirable as it kneads the metal and produces more reliable interlocking of the grains. After a certain amount of cold-working, it is necessary to anneal in order to re-crystallise and remove the distortion produced by the strain. The time of annealing and the temperature must not be so great as to cause a rapid growth of crystals, since this will result in coarse crystals being formed with consequent loss of elastic strength. This precaution is of the greatest importance after the final drawing, and the metal must be annealed just sufficiently to remove strains and distortion of crystals, and yet reserve an even, fine grain. The temperature of the furnace, time of annealing, size of charge, and thickness of the tube are all factors in the annealing process. As the alloy and thickness of the tube vary, it is necessary that the size of charge, temperature, and time of annealing be properly regulated, to secure the desired annealing conditions. To a certain extent a longer time of annealing at lower temperature is equivalent to a shorter time at a higher temperature and *vice versa*.

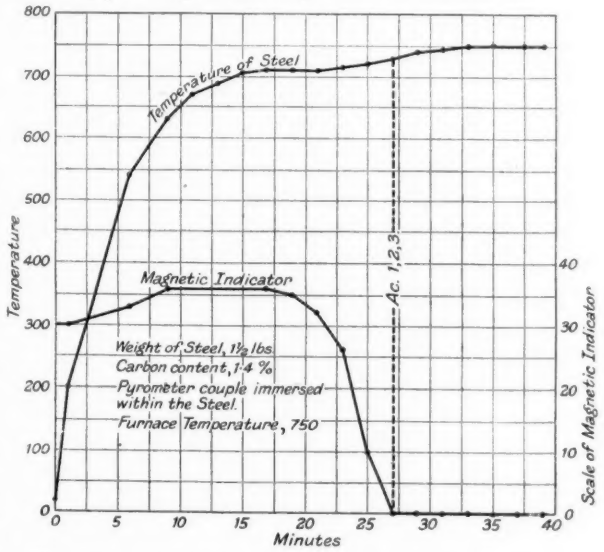
The oxidation of the atmosphere causes a scale of oxide to form on the surface of the metal during the foregoing operations. As the scale must be removed before the succeeding drawing operations are conducted, the tubes are raised in bundles and dipped in a tank of dilute sulphuric acid which dissolves off the oxide, leaving the tubes clean. The final operation consists of passing the tube through a straightening machine which removes any bends, etc.

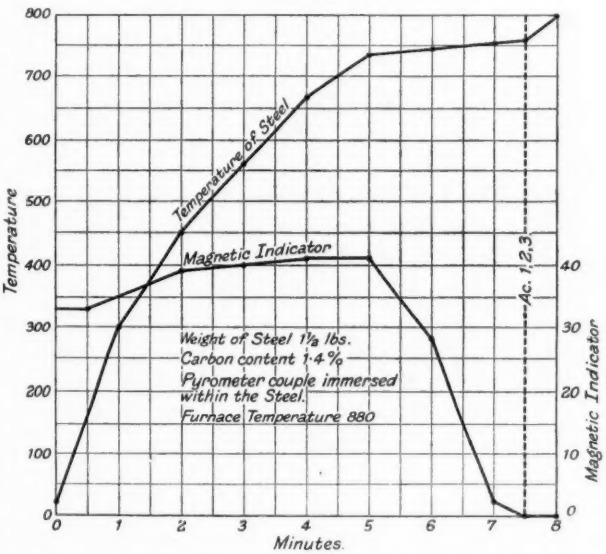
To protect tubes from the erosive action of water, resistant varnishes have been employed. The difficulty experienced with these was that they became washed away in places, thus exposing portions of the bare metallic surface to be corroded. To successfully apply the varnish it is necessary to dry it by the admission of steam to the condenser, when it is expected to be more able to resist abrasive influences.

Steel Hardening Tests

SIR,—Increasing interest is being shewn by manufacturers with a view to obtaining the best results in hardening and a greater reduction in wastage.

It is now almost common knowledge that the hardening of steel does not depend upon temperature alone, but is also governed by the rate of heating. This last factor is too often ignored, with the result that although full file hardness is obtained, yet really satisfactory "life" is not secured.





We enclose herewith the temperature curves of a steel when heated at two different rates. It will be seen that when heated slowly the steel reaches its critical point at a temperature of 730° C., but if heated more quickly, but not excessively quickly, the critical temperature is 760° C.

This interdependence of time and temperature is not sufficiently appreciated by hardeners, but it is extremely important, as an overheat of 30 degrees such as must so easily occur in practice, besides leading to a coarsening of the grain with a consequent shorter life, also leads to greater liability to crack and distort in quenching. We shall be pleased to send copies of these curves to any of your readers who may be interested.—Yours, etc.,

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Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

A New Kind of Foundry Test Bar

IT is extremely doubtful whether any form of test bar devised for use in foundry practice can afford any real information as to the soundness or otherwise of a given casting. A casting test may have some empirical utility in helping the foundryman to ascertain the right heat and rate of casting. to adopt. Seeing, however, that in order to secure, so far as possible, identical conditions of casting both for the test bar and for the actual casting—they must be cast simultaneously—the information supplied by the test bar will, to say the least of it, be somewhat belated, while its soundness can hardly be taken as proving the soundness of the casting itself. French foundrymen would appear, however, to think otherwise, and as the technique of French foundry practice has attained to what is admittedly a very high level of efficiency, it is of interest to note the proposal of Mr. A. Portevin, a distinguished French metallurgist, to adopt a pouring test of an entirely novel description, on the lines suggested by two Japanese metallurgists some years ago. The term coined for the property of the metal sought to be ascertained is the somewhat uncouth word "coulabilité." The exact translation of this term would be "pourability," which at first sight appears to have the merit of clearly defining the property in question. Broadly, the proposal is to run a spiral test piece, simultaneously with the actual casting, and, apparently from the same head, the spiral test being suitably "gated" to the body of the casting. The "pourability" of the metal is to be gauged by the degree to which the spiral mould fills, this being measured in comparison with its total length. Fluidity tests have been in use for years, so that, on further consideration, and in view of the novelty claimed for the new test, it will be evident that Mr. Portevin's "pourability" is not to be confounded with fluidity; the property implied, although somewhat similar, is not identical. Fluidity is to be regarded as a property *per se* of the metal; a function of the temperature and composition. Pourability, on the other hand, would appear to be the property possessed by the molten metal, of filling the mould—a function, not of temperature and composition alone, but of rate of pouring, pouring-head, nature of mould, intricacy of pattern, temperature of mould, and the thousand and one other conceivable factors that distinguish a successful casting from a waster. The property is thus found to be akin to viscosity, but Mr. Portevin is probably well advised to evade the use of this well defined but much abused term, which means one thing as applied to solids, another as applied to liquids, and another as applied to gases, and all three, or none of them at all, as applied to the amorphous cement of which so much has been heard of late. It will be interesting to see if the new pourability test proves to be of real value.

Amorphous Cement

APROPOS of the amorphous cement theory referred to in the above paragraph, it would seem that, as a working hypothesis, it has come to stay, not so much on its intrinsic merits as because no really satisfactory solution of the facts has as yet been put forward as an alternative. It is true that the assumed viscous nature of the intercrystalline matter is one which presents considerable difficulty. Viscosity is, however, a portmanteau word which sometimes means little or more than resistance to shear, and in any case the line of demarcation between liquids and solids is already tending to disappear. In the meanwhile the amorphous theory finds many adherents in this country and some stalwart defenders in America. Zay Jeffries, in his new book on the *Science of Metals*, dismisses Beilby's original form of the theory and adopts Rosenhain's, practically without reservation, and summarises his statement of the facts by saying that "certain properties of cast metals, or metals which have been worked and annealed, are satisfactorily explained only on the assumption that the metal at the grain boundaries is in a substantially amorphous condition." The controversy will now take the form of a discussion as to what the word amorphous really means. Strict adherents of the view that "once a crystal always a crystal" will doubtless have something to say, and in the meanwhile the "substantially" amorphous material, ever evasive, resembles in its humble degree the equally evasive ether, and continue to display properties as incompatible with each other as those of that hard-worked if nondescript entity.

Iron and Steel Statistics

THE annual issue of *Statistics of the Iron and Steel Industries* has been issued by the National Federation of Iron and Steel Manufacturers. It bears the date "February, 1925," and contains tables of output and production, and imports and exports for the home and leading foreign countries, up to the end of the year 1923. The previous issue, in 1924, gave similar statistics of the trade for the year 1922. The current issue does no more, therefore; than add the final and revised figures for 1923, one year later, and thus still lags one year behind the times, seeing that the Federation, in its monthly *Bulletin*, gives the figures for production, etc., up to the end of 1924, and, indeed, for the earlier months in the current year, in each successive monthly issue. It is true that as only what are termed the monthly averages of production are given, any one who requires to ascertain the annual production is compelled laboriously to tot up the twelve corresponding columns given in the *Bulletin* for himself. The reason for this is not easy to see. It is true that the figures are more or less provisional, and are, later on, in the annual issues, subject to a certain degree of rectification and revision, but this proviso applies with equal force to the monthly averages themselves, and if these are of sufficient approximate accuracy to be worth publishing at all, it is difficult to see why the sum total cannot be given as well and included in the current annual issues. It would be easy to "star" the figures as provisional and subject to final correction in future issues, or to adopt some other form of warning. As it is, the annual issue is always a year behind, notwithstanding that assumedly reliable figures for a later year are available in a separate publication issued by the same bureau. As they stand the returns are of value to the professional writer on economic subjects, or the Member of Parliament in search of meticulous accuracy, but not up to date enough for the busy man who has to turn elsewhere for the latest available information. Subject to the above criticism, the tables are of immense value, and have been compiled with the usual care and accuracy which always characterises the work of the Statistical Bureau of the Federation.

The Hamilton-Evans Stainless Steel Process

MUCH of the cost of making stainless steel results from the necessity of keeping the carbon content of the metal as low as possible. The presence of chromium has the effect of greatly lowering the carbon content of the eutectoid, so that the ultimate influence of the carbon is out of all proportion stronger than in the case of a plain carbon steel. A proportion of carbon, which in a plain carbon steel will confer a given degree of hardness, will in the presence of chromium have a three-fold effect. The resulting product may thus be too hard for any practical purpose, as it cannot be satisfactorily worked or heat-treated. In the usual practice of stainless steel manufacture, ferro chrome, practically free from carbon, is required, and this alloy is so expensive that the employment of stainless steel finds itself restricted by the resulting high price of the product. Mr. H. S. Primrose, in an interesting paper read recently before the Manchester Association of Engineers, gives the cost of producing mild stainless steel in ingot form, by the ferro-chrome process, as about £65 per ton. He also describes an alternative process which presents, from the point of view of technical metallurgy, an exceedingly interesting example of the influence of a slag upon the reactions occurring in the underlying metal bath. In the process described mild steel scrap is melted in the usual way, in an electric furnace of suitable design. Instead of ferro chrome being added to the bath the much cheaper chrome ore is employed. It is necessary that it should be as rich as possible in chromic oxide and in iron oxide. The chrome ore, intimately mixed with ferro silicon, is added to the slag, whereupon the silicon reduces chromium, and while the resulting silica combines with the lime already present in the slag, the chromium itself drops into the bath, in which it subsequently

diffuses. The ferro silicon used has of course to be carbon free, but it is easier and cheaper to obtain carbon-free ferro silicon than carbon-free ferro chrome. Some 60 to 70 per cent. of the silicon is used in reducing the chromium and iron oxides, but this process must not be carried too far, and some 25 per cent. is left unreduced, as the slag if exhausted would tend to corrode the furnace linings. The Hamilton-Evans process would appear to embody a valuable working proposition, as the cost of mild stainless steel produced by this process is estimated to be about £30 per ton, or well under one-half of the competitive ferro-chrome process.

Coal-Washing Plant

A British Baum coal-washing plant has been erected by the designers, Simon, Carves, Ltd., of Manchester, at the Woolmet Colliery of the Niddrie and Benhar Coal Company, Ltd. The washer will purify from stone, shale, and inorganic matter all coal which passes through a three-inch mesh. Raw coal is emptied into a reinforced concrete feed hopper with a capacity of 120 tons, of which the upper part is designed to receive coal from the picking belts by means of conveyors and the underground part to receive coal from wagons. From the hopper the coal is carried to the wash-box by means of an elevator 88 ft. long with consecutive buckets. This wash-box has two sections. The large dirt and heavier materials is collected in one section and delivered to an elevator, while the coal with lighter dirt overflows into the second section and then passes into the second elevator. All foreign materials are drained from the elevator buckets, which are perforated, before they reach the bunkers for delivery into wagons or to the bing. The washed coal is sorted by classifying screens and delivered to the various bunkers. All drainage is collected and pumped to an elevated conical setting tank of concrete with a capacity of 160,000 gallons. All fine solids and slimes are guided to the bottom and flow to sieves, and finally delivered to the storage bunker. A powerful pump, driven by an 80 h.p. motor, deals with all the drainage and circulating system. The rest of the machinery is driven by a 100 h.p. motor.

Alluvial Tin in Cornwall

The launching at Goss Moors, near Roche, recently of a 200-ton tin dredger marked a new departure in alluvial tin mining in Cornwall. The dredger cost over £15,000, and, although a familiar feature of operations in the Malay Straits, had not been previously used in Cornwall. It has been built to the orders of the British Alluvial Tin Syndicates, Ltd., who have leased over 1,000 acres of alluvial tin deposits from Viscount Falmouth. The dredging apparatus on the ship is worked by three 80 h.p. engines, the whole operation of converting the alluvial into tin concentrates being carried out on board as the dredging proceeds. It has forty buckets, which are capable of dealing with three tons of alluvials per minute, and has on board 16,000 square feet of dressing tables. It is stated that the alluvial deposits being worked assay 70 per cent. of tin concentrates, which, with the price of tin metal at not less than £200 per ton, are worth £140 per ton. The area to be worked is estimated to yield 7,000 tons of tin concentrates. The prospect of a long period of employment to a considerable number of men is a source of much satisfaction in the county, where employment in the tin industry has been very restricted for a long time.

The "Emperor" Chrome Nickel-Alloy

An interesting and important product for many industries is the "Emperor" chrome-nickel alloy of Sutcliffe, Speakman and Co., Ltd., of Leigh, Lancashire, which contains a high percentage of nickel and possesses remarkable resistance to both heat and acids. Chromium alloys are, of course, characterised by non-corrosive properties, as is strikingly illustrated by stainless steel and iron, and the "Emperor" alloy possesses possibilities in connection for chemical industries and the application of acid and corrosive liquids generally. Also, it is being extensively employed in the manufacture of articles such as rings, liners, and valves for pumps, high grade steam fittings for superheated steam under modern superpower station conditions, and many scientific instruments, discs for steam meters on the "Venturi" principle, and pyrometer pointers being cases in point.

The alloy is particularly striking as regards heat resistance and is therefore of value in many metallurgical operations. Thus, in the first place, it will stand a permanent temperature of 1750°-1800° F. without scaling, warping or cracking, whilst under these severe conditions the tensile strength remains at the extremely good figure of 30,000 lb, and when cold is about twice that of cast iron. Also it has about the same hardness as the latter metal and is therefore valuable for the construction of boxes, pans, crucibles and similar appliances for furnaces, as well as hardening pots and boxes, glass moulds and many similar uses in connection with general kiln and furnace work.

The price is considerably higher than that of either cast iron and steel, but the net advantages are superior. One indication of this, for example, in the iron and steel industries is the fact that annealing boxes made of "Emperor" nickel-chrome alloy will last at least 5,000 hours, whereas the life of plain steel boxes may only be about 200 hours, or even less. The absence of scaling means a considerable increase in the rate of heat transmission, the nickel-chrome containers need to be only about half the thickness of the steel variety, the heat conductivity is much better, and the furnace is rendered of larger net capacity.

High Power Metallography

Many prominent metallographical investigators, in spite of disparagement from the majority of workers, are still vainly searching for further insight into the constitution of alloys by means of very high magnifications. Interest in the subject was revived at Sheffield last week at the meeting of the Royal Microscopical Society, when a paper was presented from Mr. Francis F. Lucas, of the Western Electric Company, New York. The author suggested that because of the inertness of metallographers towards the higher degrees of resolution of which the best objectives where capable, it could not be regarded that the microscope had yielded its basic store of knowledge. Many beautiful photomicrographs illustrated the paper, but, like many of their predecessors fighting the same cause, they failed to sway observers to Mr. Lucas's point of view, and many boldly criticised his contentions. Much fruitless argument and research frequently arises among practical workers through a confusion of image magnification and resolution. The difference is difficult to define simply, but to anyone practised in the observation of micrographs it is readily apparent. Resolution is secured by the magnifying effect of the series of lenses comprising the microscope objective, and resolution is the true magnification upon which the value of microscopic research rests. Practical difficulties stand in the way of utilising the high resolution for which Mr. Lucas pleads. Objectives for high power work must be very accurate, and consequently they are very costly. The setting is very delicate owing to the high curvature of the lenses, and the pieces must be very carefully handled. Image magnification is necessary to make the structure already refined by the objective easily discernible by the eye or of a convenient size for preserving photographically. Such magnification is secured by the use of high power oculars, long camera extension and the interposition of auxiliary lenses. The super microscope relies for its high magnification upon these devices. Experience has shown that the advantages of a low image magnification are not increased at high values. In fact, a structure already clearly refined may be seriously confused by too high image magnification.

Aluminium Production

The figures of last year's aluminium production in Norway, recently announced, add further wonder to the story of our most interesting industrial metal. It requires two years yet to the centenary of the first isolation of aluminium. Seventy years ago the metal was still a curiosity, but a sample exhibited in Paris in 1854 created such a furore that the preparation on a "commercial" scale was at once started. At this time aluminium cost about thirty shillings an ounce. It was not until after the invention of the modern electrolytic processes in America and England in 1886 that economical production commenced, and by 1900 the price had fallen to its present value of about a shilling a pound. Each year sees a remarkable increase in the world's output. Definite figures are difficult to obtain, but in 1920 the output appears to have been about 150,000 tons. At the present time it is probable that a quarter of a million tons per annum are manufactured. Norway alone contributed 22,000 tons in 1924, nearly four times her output of ten years ago, and she claims to have now reached second place among the aluminium producing countries. The United States is easily first.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

THERE has been some amount of liveliness during the month of April, but not in the right direction. Business has been just as scanty as in the previous month. The iron and steel trade seems to be in a state of stagnation, with little prospect of improvement. The closing down of furnaces and mills continues. Even the railways are feeling the pinch; there have been announcements recently that both the Great Western Railway and the London and North Eastern at Doncaster have had to reduce the number of men or put them on short time.

Failure to Control Steel Prices

Now comes the news that the attempt to control the prices of steel has failed, and that, with the exception of boiler plates, makers are free to quote what prices they like. This decision may be due to a belief that business which has been held back will now be placed, but it is more likely that business which would have been placed, had there been no alteration, will now be held back until the market has again reached some degree of stability. We cannot see that the reduction in prices will bring out any greater weight of orders. If British steel has to be used, then the prices were already low enough, in some cases too low, particularly for plates. If continental steel is acceptable, a reduction of 10s. or even 20s. will not keep it out, as the disparity between continental and home prices is too great.

The trouble seems to have arisen since the North-East Coast makers reduced their price for plates to £8 17s. 6d. for their own district. It was done ostensibly to help the shipbuilding trades, although that help was more apparent than real. The price of plates was not the chief difficulty; internal costs and labour restrictions were more weighty factors. To the steel makers themselves this reduced price, practically an f.o.r. price, was no worse than £9 15s. delivered into the Midlands with a carriage of 17s. per ton or more. Nevertheless, the users of plates in the Midlands complained that they were at a disadvantage as compared with their competitors on the coast, who could buy at lower prices, and in addition had no heavy carriage to pay on their finished products for export.

After all, the price regulation was very much of a sham. It has long been known that the official prices were to a large extent only nominal and that there would be no difficulty in getting reductions for any good order that might be offered. Even boiler plates, which are still officially controlled at a reduction of 10s. per ton, have been subject to the same cutting. Consequently, the lower prices that are now being talked of for plates are very little different from those which have actually obtained for some time past, although there is no doubt that still lower prices will soon be in evidence. As we have pointed out, the chief effect of the break up of the Association will be to upset the market and, for a time at any rate, increase the stagnation.

Lower Manufacturing Costs

It is a pity that this has happened just at a time when the steel maker was obtaining some relief in his manufacturing costs. Coal and coke prices have fallen considerably since the end of March, and the reductions mean round about 10s. per ton on the cost of finished steel. That was at the beginning of April, and coal prices have weakened still further since then. Scrap has also fallen heavily. It is easy to buy heavy scrap for steel making at 70s. and it is not very difficult to obtain supplies at 67s. 6d. That compares with 75s. to 80s., which was the market figure not long ago. Stocks have accumulated owing to the inability of the steel makers to take deliveries, and the scrap dealers are only too glad to turn them into money. In this, as well as in fuel, it is the usual effect of an excess of supply over demand. Yet this advantage in the cost of raw materials is about to disappear in the usual way. It is passed on to the consumer, and the steel maker continues to struggle to make ends meet.

Really it would have been better to maintain prices at their old level and so avoid the necessity of advancing prices, which will be inevitable when trade does begin to move. As soon as the works get busy the cost of fuel and scrap, particularly the latter, will increase, and the steel maker will either have to face losses or ask a higher price for his steel, which straightway means a check on business. Had the price of £9 15s. for plates been maintained, low as it is, an upward movement in trade could have been met without immediately advancing prices.

Business Morality

The difficult times which the iron and steel trade has been experiencing for so long are not without their effect on business morality. This break-up of the Association is one sign of it. It is true that there has always been trouble with price associations in bad times, but the violation of agreements is rather too much in evidence. Another disturbing feature is the tendency for firms to avoid their contractual liabilities. Contracts in the steel trade are usually interpreted in a broadminded way, but steel makers are finding, in numerous instances, customers who, being left with high priced contracts, either ignore them and place their orders elsewhere or calmly ask for the contract to be cancelled. It is to be hoped that this tendency will soon disappear, and that business relationships will not fall from the high standard which they have so long maintained.

Continental Competition

Competition from the Continent continues without any marked changes. Germany appears to be rapidly approaching complete restoration as far as her iron and steel trade is concerned. The pre-war selling organisations have been revived and are even more powerful and efficient than they were then. There is no doubt that they are preparing to make a definite bid for world trade, and it will need all the resources and ingenuity of the British makers to compete with them. Nevertheless, we are inclined to believe that the competition will be a comparatively straight one. In some instances the manufacturing costs in Germany are higher than ours, but the makers there excel in the economies to be effected by efficiency in the works and by co-operation. The labour costs are less than ours, but the margin is tending to decrease. The competition from France is a different matter. The works which were taken over after the war have to be kept going, and it is no secret that the French can never work them so efficiently as the Germans did. We are convinced that the French Government is paying large subsidies to various firms to ensure that the works are kept in operation. That introduces a form of competition which it is exceedingly difficult to meet. It is fraught with danger to France herself, and the sooner that country returns to a state of financial stability the better it will be for the whole of Europe.

Easter Holidays

The Easter holidays have naturally interfered with the trade of the month. Many firms closed down for a longer period than usual owing to the scarcity of orders, and the inclination in some quarters is not to restart until better prospects are in view. The general recovery from the holidays is very slow. Pig iron has shown further weakness during April, especially towards the end of the month. Prices have fallen about 2s. 6d. per ton generally, and individual sales have been made at ridiculously low prices. Further furnaces have been or are to be blown out, including the two remaining furnaces at Thornaby works. The remaining furnace at Seaton Carew is to be blown out.

In bar iron business is very slow indeed, and it becomes increasingly difficult for the home makers to secure orders in face of the tempting offers from abroad. Unfortunately, there seems to be no way of surmounting this obstacle. It is no use trying to do it by reducing costs, as the margin is too great. The same applies to many branches of the steel trade. Several of the British steel-making firms are now buying foreign steel and rolling it down; and it is to be feared that in some cases the product is sold as British steel.

Relief of Industry

Schemes are still being mooted for the relief of the industry. There are some optimists who are hoping for help from the Safeguarding of Industries Act. Sir Alfred Mond has issued his proposals for using the unemployment insurance benefit to assist employment, by paying the money to the employers to enable them to find work for the men. The same suggestion

was made in our last month's report. We have also heard that there is a possibility of a Government subsidy being granted on coal for steel making and for export. On the face of it that seems a sensible way of rendering assistance, as coal is one of the chief items of cost in steel making, and a small reduction in the price means an important saving in the finished steel.

The production of pig iron in March amounted to 607,900 tons compared with 541,900 tons in February and 668,600 tons in March last year. The production of steel ingots and castings amounted to 684,700 tons compared with 652,300 tons in February, and 816,900 tons in March, 1924.

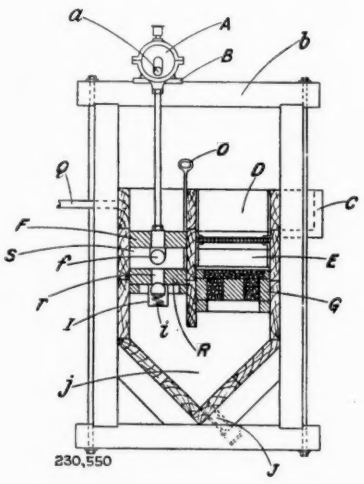
Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Concentrating Ores

A MACHINE for concentrating and separating ores according to specific gravity by the action of water has been patented by E. Harr, of Halifax, Nova Scotia. A plunger *F* is reciprocated by a number of eccentrics *A* on a shaft *a*, each eccentric having a rod which is connected to the long horizontal plunger. The plunger carries one-way ball valves *f*, and similar ball valves *i* are carried in the bottom plates *R* of the chambers.



The plunger is reciprocated at 300 vibrations per minute, so that the vibrations are transmitted through the water *f* to a shot bed *G* at the bottom of a chamber *D*. A reciprocating screen is arranged at one end of the chamber *D* to feed the material into the machine. The vibration of the water through the shot bed causes the heavier concentrates to pass downwards into the lower part of the machine, while the lighter portions are retained above the shot bed. See Patent No. 230,550, dated December 13, 1923.

Steel Alloys

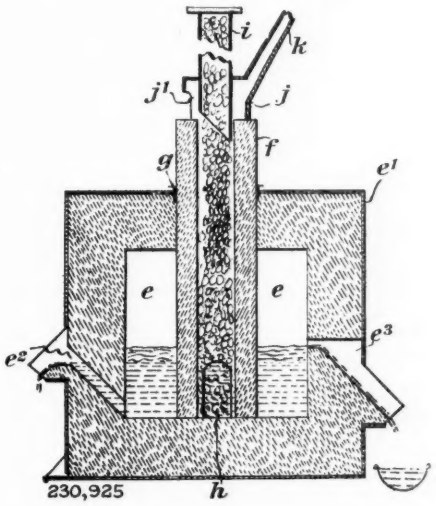
A mild steel alloy capable of being worked into boiler tubes, and also capable of resisting corrosion has been patented by W. J. Talbot and Talbot-Stead Tube Co., Ltd., of Walsall, Staffs. The starting material is a mild steel containing not more than 0·04 per cent. of silicon, 0·05 per cent. of sulphur, and 0·05 per cent. of phosphorus. This is melted, and copper, 0·12 per cent. and chromium 0·2 per cent. are then added. This alloy works as readily as ordinary mild steel. See Patent No. 230,958, dated January 24, 1924.

Purifying Metals

According to a patent by Sumet Corporation of New York, for eliminating sulphur and phosphorus from metals, the molten metal is treated with hydrogen at a high temperature and low pressure. The hydrogen is obtained by decomposing steam with iron at a high temperature. See Patent No. 231,279, dated February 4, 1924.

Smelting Tin

According to a patent by M. Stroman, of La Paz Bolivia, tin and other ores are smelted in a tube or shaft of refactory material, so that they are not exposed to the furnace gases. The furnace comprises a chamber e of refactory material, having an outer covering e^1 of sheet iron. Openings e^2 are provided for the molten metal, and e^3 for the slag. A tube or shaft f passes downwards through a stuffing box g, and rests



on the bottom of the chamber e, while openings h are provided for the escape of molten metal. The mixture of ore and fuel is fed in through a pipe i having a bevelled lower end, and surrounded by a casing j having an inspection opening j^1. The reaction gases are carried off by a pipe k. The reduction of the ore takes place in the tube f, and the metal in the chamber e is also protected from the furnace gases by the layer of slag. See Patent No. 230,925, dated December 20, 1923.

British Chemical Standard Iron Ore

HEADQUARTERS of the British Chemical Standards movement announces the issue of the final edition of the certificate of analyses of Iron Ore "A" (hematite type) showing the standardised complete analysis as follows :—

(Sample dried at 100 to 110 deg. C.)

	Per cent.
Iron	58·20
Phosphorus	0·056
Arsenic	0·011
Copper	0·037
Mn, Ni, Co, Cr, V, Zn, and Pb	Trace or nil
Lime	2·05
Magnesia	1·22
Alkalis	0·335
Alumina	1·83
Titanic Acid	0·116
Silica	8·13
Sulphur	0·063
Oxygen	25·031
Combined water, carbonic acid, etc.	3·06
	100·139

The final certificate includes about four pages of notes giving a considerable amount of useful information about the methods actually used by the different chemists in Great Britain, France, and Spain who took part in the standardisation. A copy of the certificate accompanies each bottle of the standard issued. The standard is available to anyone at a price sufficient to cover the cost of preparation. Application should be made to Headquarters, 3, Wilson Street, Middlesbrough.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

CORROSION.—Corrosion symposium. *J. Ind. Eng. Chem.*, April 1925, pp. 335-392. A collection of papers summarising the progress of research in connection with the corrosion not only of metals but also of glass.

Water-line corrosion of iron and steel, with special reference to the action of the so-called "inhibitors" of corrosion. U. R. Evans. *J.S.C.I.*, April 10, 1925, pp. 163–169 T.

ELECTRO-DEPOSITION. — Electro-plating costs. J. Haas. *Metal Ind. (Lond.)*, April 17, 1925, pp. 386–390. Description of a method for the organisation of plating shop costs.

COPPER.—Some principles of modern copper leaching. G. D. van Arsdale. *Mining and Met.*, April, 1925, pp. 174–177. A description of the wet methods of treating copper ores.

LEAD; ZINC.—Concentration of lead-zinc ores of Eastern Canada. C. S. Parsons. *Canad. Chem. Met.*, April, 1925, pp. 89–92. A selective flotation method for separating lead and zinc.

IRON AND STEEL.—The chemistry of iron and steel. Part III. F. T. Sisco. *Trans. Amer. Soc. Steel Treating*, April, 1925, pp. 494–517. A discussion of the chemical reactions taking place in the basic open hearth process.

Recent developments in case hardening. Part III. A. R. Page. *Metal Ind. (Lond.)*, April 3, 1925, pp. 345–347. Deals in particular with heat treatment, selective case-hardening, and the causes and avoidance of soft spots and exfoliation.

The preparation of iron and steel wire. H. Altpeter. *Stahl u. Eisen*, April 16, 1925, pp. 569–581 and April 23, 1925, pp. 614–625 (in German). A comprehensive, illustrated description of wire manufacture.

Semi-steel. H. Field. *Metal Ind. (Lond.)*, March 27, 1925, pp. 323–324 and April 3, 1925, pp. 347–348. Describes experiments indicating that steel melted in the cupola does not absorb carbon before melting.

ALLOYS.—Secondary crystallisation in iron-carbon alloys. V. N. Krivobok. *Trans. Amer. Soc. Steel Treating* April, 1925, pp. 457–485. An illustrated description of the two extreme types of cast steel structures.

The inner structure of alloys. *Metal Ind. (Lond.)*, April 10, 1925, pp. 361–364. An explanation of the nature of typical alloy systems and of the correlation of their physical properties with the atomic arrangement.

Some examples of equilibria drawn from the study of alloys. Distinctions between the equilibrium of metallic phases and of amorphous phases. G. Grenet. *La Technique Moderne*, March 15, 1925, pp. 164–167 (in French).

Magnetic properties of the fifty per cent. iron-nickel alloy. T. D. Yensen. *J. Franklin Inst.*, March, 1925, pp. 333–342.

ANALYSIS.—The use of pyrogallol for the gravimetric determination of bismuth and its separation from lead. F. Feigl and H. Ordelt. *Z. anal. Chem.*, Nos. 11–12, 1925, pp. 448–451 (in German).

VANADIUM.—Vanadium: its production and commercial applications. A. J. Ewins. *Ind. Chem.*, February, 1925, pp. 3–4.

GENERAL.—The hardening of metals. G. Sachs. *Z. Metallkunde*, March, 1925, pp. 85–93 (in German). A discussion of the effect of cold deformation, alloying and heat treatment.

Polishing of iron and steel specimens for metallographic examination. C. O. Burgess and J. R. Vilella. *Trans. Amer. Soc. Steel Treating*, April, 1925, pp. 486–493.

American Loan for German Mining

REPORTS from Berlin state that the German Luxemburg Mining and Smelting Works Co. is negotiating in New York for a loan of £750,000.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

ALUMINIUM CORPORATION, LTD., London, S.W. Registered April 8, £600 mortgage, to D. Evans, Co-operative Stores, Llanrwst, manager; charged on properties at Llanrhychwyn, etc.; also registered April 11, £51,238 (not ex.) mortgage, to Conway Rural District Council; charged on property at Dolgarrog. *£1,002,040. October 22, 1924.

BEARDMORE (WILLIAM) AND CO., LTD., London, S.W., steel manufacturers. Registered March 26, bond of corroboration and disposition in security (supplemental to £600,000 (not ex.) bond, etc., dated July 9, 1924), to bank, charged on dry dock and land at Dalmuir. *£1,669,417 2s. 6d. October 23, 1924.

CONEYGRE FOUNDRY, LTD., Tipton. Registered March 31, £9,000 mortgage, to Earl of Dudley's Round Oak Works, Ltd., Brierley Hill; charged on Earl of Dudley's Coneygre Foundry, with machinery, etc.

FAIRBURN AND HALL, LTD., Stockport, ironfounders. Registered March 25, £2,000 debentures; general charge.

MUNSLOW (WILLIAM), LTD., Manchester, ironfounders. Registered April 2, charge to bank, charged on property in New Street, Miles Platting. *£27. June 28, 1923.

ROBERTS (ABRAHAM), LTD., Huddersfield, brassfounders. Registered April 9, £7,000 debentures (secured by trust deed dated March 26, 1925); charged on properties at Huddersfield, etc., also general charge.

SMITH (SIDNEY) AND BLYTH, LTD., London, S.W., ironfounders. Registered March 24, £250 debenture, to F. C. Pott, 89, Bolingbroke Green, Wandsworth; general charge. *Nil. December 31, 1924.

UNITED STEEL COMPANIES, LTD., Sheffield. Registered March 23 (by order on terms), conveyance, etc., and subdemise both dated February 10, 1921 (supplemental to trust deed dated April 19, 1918, securing £500,000 C debenture stock); charged on mines, minerals, hereditaments, etc., as set out in schedules to the particulars filed. *£2,410,898 debenture and debenture stock. £243,998 6s. 9d. mortgage. November 3, 1921.

Satisfaction

BROWN AND GREEN, LTD., Luton, ironfounders. Registered April 4, all moneys, etc., registered February 28, 1922.

Royal Society Research

IN spite of the disappointing results from high power metallography, few will deny that there are possibilities of tapping a great store of knowledge if means could be devised of seeing more of the structure of materials. The use of X-rays has given theorists an inkling of the molecular arrangement of metals. If optical methods of investigation could be discovered to bridge the gap between these surmises and our knowledge of crystallographic structure obtained from the microscope, many pressing problems would be solved. The suggestion, therefore, put forward by Sir Robert Hadfield that the Royal Society should apply the Sorby bequest to research on this subject may be cordially supported. Dr. Sorby left £15,000 in the care of the Royal Society to establish a fellowship to promote the discovery of new facts. It is difficult to suggest a subject better suited than this one to carry on the work of the founder of metallography.

Monthly Metallurgical Section

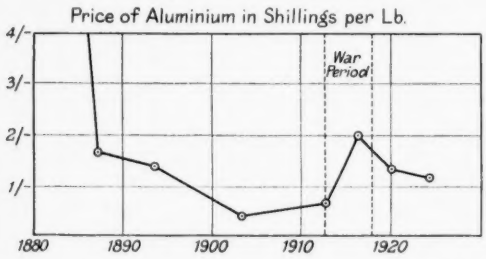
Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, 8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

Aluminium: Manufacture, Properties, and Uses

By Dr. G. Malcolm Dyson

THE most striking thing about aluminium is the extraordinary rapidity with which it has sprung into general use. A hundred years ago it was unknown, as a metal, while to-day its production exceeds 200,000 metric tons per annum. This rapid rate of progress is due, in the main, to two factors: firstly, to the eminent suitability of aluminium for many industrial operations, and secondly, to the application of electrometallurgy to the preparation of aluminium. The electrical process for the preparation of aluminium was introduced between the years 1886 and 1890, and its effect on the price of the metal can be seen from the curve below. In 1856 aluminium was priced at £25 per lb. as a chemical curiosity, while in 1913 it was 9d. per lb., and had been as low as 5d. per lb.



The metallurgy of such a "young" metal as aluminium has no need for historical treatment. Previous to the electrothermic process for its extraction, older processes had employed the use of metallic sodium as a reducing agent; but this was necessarily a great expense, especially as the yield of aluminium by the process was poor.

In the older process actually employed, 2 cwt. of aluminium chloride, 1 cwt. of cryolite, and 80 lb. of sodium were charged on to the bed of a reverberatory furnace and heated to dull redness until reduction had taken place—usually after about three hours. The aluminium was then tapped off from the well of the furnace.

Metallurgy of Aluminium

The process now used depends on the electrolysis of a solution of aluminium oxide in fused cryolite, and is thus, in turn, dependent on a supply of pure alumina. The ore from which this is at present obtained is the crude hydrated oxide bauxite ($Al_2O_3.2H_2O$), which also contains siliceous impurities, ferric oxide and a small quantity of titanium dioxide. The bauxite supplies of the world are considerable, especially those of Canada and America, while the bauxite resources of Great Britain are mainly in Ireland, where with the pisolitic iron ores they occur to a considerable extent in County Antrim.

The purification of bauxite, necessary for the effective working of the aluminium furnace, is carried on in several stages. The ore is first roasted to remove water and to convert the iron into the ferric state. The roasted ore is then ground, and agitated under pressure with a strong caustic soda lye, by which means the aluminium oxide is dissolved and the impurities left. The solution is filtered from any such impurities, and the aluminium precipitated as hydroxide. This used to be brought about by the use of carbon dioxide, and other precipitants, but is now performed by the simple expedient of adding some aluminium hydroxide paste from a previous batch, which induces the separation of aluminium hydroxide from the solution until 70 per cent. of the aluminium has been precipitated in this way. The hydroxide can then be filtered off, washed and dried and calcined, when it gives an aluminium oxide of about 99 per cent. purity.

Recently, a proposal has been made to revive the Serpek process for the fixation of nitrogen as ammonia, and to ensure its commercial prosperity by combining with it, the production of aluminium from the aluminium oxide which is a by-product of the fixation process. Essentially, the process is one in which a double tube furnace is used. The first tube merely calcines the bauxite, which is then mixed with coke and passes down the second tube, where it meets a stream of hot nitrogenous gases from a producer-gas plant, and passes through a resistance-type electric furnace, set across the tube, which heats the material to 1700–1800° C. Under these circumstances the reaction—$Al_2O_3 + 3C + N_2 = 2AlN + 3CO$ takes place, and the aluminium nitride is withdrawn at the lower end of the tube-furnace as a greyish powder. This nitride is then treated with a strong soda solution, when ammonia is evolved as a gas, and aluminium oxide produced. This latter product alone, dissolves in the excess of caustic alkali, so that the solution can be filtered from the impurities, and treated for alumina, as in the above process. The success of the process depends on getting a good yield of the nitride continuously, a state of things which was very far from being realised in the older plant.

The actual reduction in the furnace is a comparatively simple operation, although the long continued electrolysis is not nearly so efficient as would be theoretically expected, since there is loss of both current and metal, by "fogs" in the electrolyte. The furnace, which is usually of the "box" type, is charged with a mixture of cryolite chippings and aluminium shavings, over a bed-cathode of carbon blocks. The anode, a series of carbon blocks clamped together, is then touched down on to the bed, drawn away, and the arc started up. This melts the cryolite and aluminium, and when they are quite fluid, the aluminium oxide is fed in and electrolysis takes place. The aluminium separates at the bed of the furnace, and oxygen is liberated at the top. This liberation of oxygen causes considerable expense in the renewal of the carbon anodes, which rapidly burn away under its influence. The lining of the furnace also presents another problem, that of corrosion by the furnace contents. Both firebrick and compressed carbon have been tried, but it is found that they are rapidly eaten away. Thick sheet iron has been found to be the most efficient lining.

Commercial aluminium contains about 98 per cent. of the metal, but the removal of the two per cent. of residual matter is a difficult task, although part of the impurities can be removed by the prolonged fusion of the metal in contact with the atmosphere, when the impurities, together with some of the aluminium, are oxidised and can be skimmed off as dross. Where chemically pure aluminium is required for laboratory purposes, a chemical method of purification is resorted to. The aluminium is converted to the bromide, which is then fractionally distilled until a compound of constant B.P. is obtained. This can then be reconverted into pure aluminium.

The Metal

Aluminium is a moderately soft metal, with a colour intermediate between that of silver and of lead. It transmits light when in thin layers, the light being brown or violet according to the thickness of the layers. The metal can be obtained crystalline, and X-ray analysis has shown it to have a face-centred cubic lattice. A peculiar feature of commercial aluminium is that it has a definite smell. This is due to the presence of silicon as an impurity, the aluminium silicide

giving off traces of silicon hydride with the moisture of the atmosphere.

Among the advantages of the use of aluminium is the fact that it is comparatively easily mechanically worked. It can be annealed, when hardened by working, and this fact combined with its very low specific gravity accounts for its extended use. Worked hot, it becomes strained, and is usually annealed and finished to gauge when cold. Pure aluminium has a density of 2·58, about one-third that of cast iron, a fact that, taken together with its mechanical strength (12,500–15,000 lb. per sq. in. for the tensile stress) and resistance to corrosion, has made it valuable for the construction of many utensils, including those used for cookery, storage tanks, vessels for varnish and wax boiling, and also for condenser tubes. Utensils of aluminium can be prepared in either of two ways—"spinning" or casting. The spun vessels are thin, and although light, are too easily deformed, while those of cast aluminium, although substantial, have an irregular "pitted" surface, which offers considerable facilities for corrosion. This can be corrected by planishing the surface, since the cold working gives the aluminium a smooth surface, with a hardness equal to that of brass.

Aluminium becomes fairly hard when worked cold (hardness on the Brinell scale 23–28), but the final hardness of the metal depends to some extent on its heat treatment. Thus cold rolled aluminium is hard but can be annealed by heating to 400° C. and cooling. On the other hand, heating to 500°–600° C. makes the metal quite brittle, so that it can be crushed to a powder under impact. The metal melts at 658° C.

Aluminium has a high electrical conductivity, and since it can easily be drawn out into wire, is used in the manufacture of cables. These, although thicker, are lighter and cheaper than those of copper for corresponding currents. Aluminium can also be rolled into very fine foil, which is largely used to replace silver leaf in decorative work, while for wrapping purposes a thicker foil is found to be very suitable. The thinnest foil can be easily rubbed to a fine powder, or larger lumps of the metal can be crushed hot in a stamp mill, and the powder so obtained graded by sifting. The aluminium powder has many uses—it is the basis, of course, of aluminium paints and is the active agent in aluminothermic reduction, or the Goldschmidt method of metal extraction. Aluminium has an extreme affinity for oxygen, and in its combustion intense heat is liberated—in fact, a mixture of aluminium dust and air constitutes a violent explosive, and many accidents have occurred in the sifting and grading rooms of aluminium powder manufactories from this cause. This intense oxidation energy is made use of in the aluminothermic reduction process. The oxide of the required metal is mixed with coarse aluminium powder, and the mixture ("Thermite") ignited by a special firing powder. The aluminium seizes on the oxygen of the metal oxide, forming aluminium oxide, so liberating the metal, which sinks to the bottom of the mass, melted by the heat of the reaction. This process has been successfully used for the preparation of such refractory alloys and elements as chromium, manganese, molybdenum, boron, silicon, ferro-titanium, ferro-vanadium, copper manganese, etc., and has also been used with great success in welding operations on steel and iron. In this latter operation, a clay mould is built up around the two portions to be welded, and is filled with an iron oxide thermite, which on ignition not only raises the metal to a white heat, but by producing liquid iron cements the two portions into a homogeneous mass.

A further use to which aluminium powder has been put, is the manufacture of ignition mixtures for firing depth charges. These mixtures consist of aluminium powder and certain oxidising agents, both having been very carefully dried, and which ignite with violence when touched with a drop of water. By the addition of certain inert substances, such as lead carbonate, chalk, etc., the time of ignition can be delayed until after a certain definite number of seconds have elapsed after the addition of water. A small quantity of such a compound is embedded in the side of the explosive charge, and are connected by a steel capillary tube to the external air. On dropping such a charge into the sea, it sinks until the pressure of the external water forces water along the capillary until it touches the ignition mixture, and so fires the charge. The length of the capillary is, of course, predetermined for the requisite time or depth required.

Aluminium powder has also been used for the preparation of explosives of the "ammonal" class, a typical member of which class contains 47 per cent. of ammonium nitrate, 1 per cent. charcoal, 30 per cent. of T.N.T. and 22 per cent. of aluminium powder. This mixture is compressed, heated to 67° C. and then dipped in molten T.N.T. and cooled in a stream of air. Among the other uses of aluminium we may also mention its function in steel-casting. Steel when poured molten into the ladle, boils for some minutes, before the crust of solid metal forms, and when poured into the moulds the metal rises to a height of several inches in the moulds, giving an irregular, porous crust of metal. The addition of a few ounces of aluminium to the steel shortens this period of ebullition to a few seconds, and makes the crust in casting much less thick. Consequently metal is saved, far in excess of the cost of the aluminium added, and in addition, the aluminium, by taking up as oxides, gaseous impurities, renders the casting more free from flaws and "blowholes," which detract from its mechanical strength.

Alloys of Aluminium

Aluminium forms alloys with a great many metals, and many of the alloys so formed are of first industrial importance. Special types of furnaces have been devised for the preparation of these alloys, without the separation of the aluminium as such. That devised by Borcher, consists in heating a "cartridge" of clay, carbon, and copper oxide, in an electric furnace of the carbon resistance type, so that a copper-aluminium alloy can be tapped. The aluminium-copper alloy is known as aluminium bronze, and the presence of the copper confers considerable mechanical strength on the alloy. One per cent. and 5 per cent. bronzes are used, and the unqualified term "aluminium bronze" is usually taken to signify a 10 per cent. bronze. This latter alloy possesses the appearance of standard gold, is malleable, gives fine castings, and polishes well. It is nearly equal in strength to cast steel, but the strength depends on the purity of the copper used in its preparation. To obtain good results, only the finest electrolytic copper is admissible, since the presence of even small quantities of impurity, especially iron, gives a very inferior product.

Aluminium will alloy evenly with silver, yielding a hard, easily polished alloy; with 4 per cent. of silver, an alloy is obtained, suitable on account of its unalterability for the construction of balance beams and metallic scales. The substances known as "aluminium silver" contains no silver, but is an alloy of copper, nickel and aluminium, having properties similar to those of German silver. Similar alloys are :—

(1) Hercules metal—Al 1·5 per cent., Cu 61 per cent., Zn 37·5 per cent.

(2) Argentan—Al 7 per cent., Cu 70 per cent., Ni 23 per cent.

The alloy between magnesium and aluminium is of considerable importance in the construction of aeroplane engines and equipment. That with from 2 to 30 parts of magnesium to 100 parts of aluminium, or "Magnalium," is extremely light, almost rustless, and besides having considerable mechanical strength, it can be easily worked. Furthermore, it can be hardened by "quenching," and shows the phenomena of "ageing," in which, after quenching, the full hardness of the material is not developed until after several days. The strength and facility of working are increased by the addition of small amounts of copper or manganese to the alloy. Such alloys are known as "Duralumin." Alloys containing from 5 per cent. to 30 per cent. of magnesium, with a little copper, are as hard and durable as brass, while an alloy of aluminium with 70 per cent. of magnesium, 3 per cent. to 5 per cent. of copper, and ½ per cent. to 1 per cent. of manganese, is as hard as mild steel, and for these reasons is eminently suited to the construction of light engine parts.

Aluminium alloys comparatively easily with zinc, and alloys containing 20 per cent. to 40 per cent. of zinc are known as "Alzene," "Ziskon" and "Zisium," and are used in the construction of scientific instruments. Furthermore, the addition of about ½ per cent. of aluminium to the zinc used in the Parkes process for the desilverisation of lead, greatly facilitates the working of the process.

Alloys of aluminium with mercury are known, and the amalgam is very brittle, oxidises rapidly in the air, and decomposes water with ease. It is occasionally used as a reducing agent for the estimation of nitrates in water, and also for the purpose of reduction in organic chemistry.

Aluminium and its Alloys

The National Physical Laboratory's Investigation

In the annual report of the National Physical Laboratory which has just been issued there is an interesting account of the special work which has been conducted at the Laboratory in connection with the determination of means for improving the methods of melting and casting aluminium and its alloys with a view to the production of sounder castings, having higher densities and free from defects, such as porosity and gas cavities, which are common in castings of this kind. Particular value is attached to this aspect of the work in view of the increasing importance, in connection with aeronautical engines, of providing large complicated castings of considerable strength. The suggestion that such castings might be made of heat-treated Y alloy (containing copper 4 per cent., nickel 2 per cent., magnesium 1½ per cent., aluminium the remainder) has been met by the objections that complicated castings are difficult to produce in this alloy, and that there are fewer difficulties when heat treatment has been applied to them. A large amount of methodical work has been carried out by the Laboratory in order to check the correctness of these views, and, as a result, it is possible to state that castings of a very complicated kind can readily be made of this alloy, provided that suitable precautions are taken, and that such castings can be readily subjected to the necessary heat treatment without undergoing any appreciable distortion or other damage. This work was carried out on castings made from patterns which were lent to the Department by the Royal Arsenal, Woolwich, so that the castings are actual practical objects selected in view of their complexity.

Observations of the behaviour of the molten alloy in process of solidifying, and observations from castings, themselves, indicated that a good deal of the trouble which is experienced at times with Y alloy, and with other aluminium alloys, arises from the presence of gas in the molten metal. Methods of treating the alloys were accordingly studied with a view to the removal of this gas, and a considerable measure of success was attained, although much further work is required in order to put the method on a satisfactory basis.

"Y Alloy" for Castings

With further regard to the use of Y alloy for castings, the application of new methods of heat treatment was studied as the result of the work on the constitution of these alloys. While previously the best values for the strength of chill castings was in the neighbourhood of 21 tons per sq. in., it has now been found possible by further heat treatment to raise this figure to 26 tons per sq. in., thus bringing the tensile strength of a sound chill casting to the same level as that of the wrought material. It is not, however, likely that this kind of heat treatment will be adopted for practical purposes owing to the fact that the further increase in tensile strength is accompanied by a reduction in ductility, but the condition brought about by the heat treatment in question is strictly analogous to the full hardening of steel, so that a slightly lower tensile strength, accompanied, however, by greater toughness, will be preferred.

A good deal of work was done in connection with a number of industrial foundries which are now producing pistons of Y alloy. The smaller pistons are, as a rule, used in the form of castings, but for larger work 16 in. diameter heat-treated forged material has been successfully employed, and work is in progress for the application of this material to still larger sizes, such as those used for Diesel and semi-Diesel engines. An interesting use of heat-treated castings of this alloy is now being studied. This is the application of the cast material to the production of connecting rods. Actual trial of a number of these connecting rods gave interesting results; although their tensile strength and fatigue properties are not so good as those of the heat-treated wrought material (drop forging), they appear to withstand service conditions in a satisfactory manner.

With regard to the properties and use of Y alloy in the wrought condition, further attention was given to the question of cold working. Since alloys of this type undergo age-hardening to a certain extent, even when cooled at a moderate rate, their heat treatment for the production of material suitable for cold working is a matter requiring some care. This is particularly necessary where sheet and fine wire are to be produced. In connection with some requirements suggested by the British Scientific Instrument Research Association, samples of this alloy have been drawn to wire 0·004 in. in diameter, starting from a hot-rolled rod ½ in. in diameter.

Aluminium-Silicon Alloys

At the specific request of the Light Alloys Panel of the Aeronautical Research Committee, the Laboratory undertook a study of the properties of the aluminium-silicon alloys which are known under such proprietary names as "Alpax," "Silumin," etc. Alloys for this purpose were prepared in the Laboratory, and in order to ensure that the material should be examined under the best possible conditions, samples for extensive tests were also secured from Messrs. Light Alloys, Ltd., who specialise in the production of alloys of this kind. The properties investigated were tensile strength at normal and elevated temperatures, the fatigue range at normal and elevated temperatures, and resistance to impact. The casting properties of the material were also studied very fully both in this connection and in connection with die casting research. As the investigation is not yet completed, no indication of the results can be given. In the course of the work, however, some interesting observations were made upon the character of the so-called modification process by which the structure of the alloy is very markedly refined. This is usually ascribed to the influence of a small amount of sodium, which is added to the molten metal in the metallic state or introduced into it by the action of a flux containing sodium fluoride. For a time it appeared impossible to obtain aluminium-silicon alloys having the ordinary coarse structure, all the samples prepared, even without the addition of sodium in any form, showing a more or less modified structure; this was, however, traced to the presence of small amounts of calcium in the silicon employed in making the alloy.

The Preparation of Manganese

In addition to the investigations which were conducted in connection with aluminium some interesting work was carried out on the preparation of manganese. In the previous report reference was made to the preparation of metallic manganese by an electrolytic process. This process, however, has proved extremely laborious and slow, while an additional difficulty presented itself in the fact that manganese thus produced tends to oxidise very rapidly when exposed to air, even in the absence of moisture and carbon dioxide. In these circumstances, other methods of preparing pure manganese were sought, and the rudiments of a satisfactory method were found. This consists in the distillation of manganese from molten impure manganese containing small amounts of aluminium and silicon. Slightly impure manganese of this kind can be readily prepared by alumino-thermic reduction from purified manganese oxide, but the degree of purity obtainable in this way is not particularly high. It was, however, found that, by melting an impure manganese of this kind in the high-frequency electric furnace, while a good vacuum is maintained, the manganese distils off and can be collected on a suitably arranged condensing surface, where it forms a massive layer which, on analysis, shows that only traces of silicon or aluminium are carried over with the distillate. In this way adequate quantities of pure metallic manganese can readily be prepared, thus producing satisfactory material for the study of the iron-manganese system of alloys and also for the study of the properties of pure metallic manganese, a metal which has not hitherto been obtainable in any high degree of purity.

Sensitiveness of Ammonium Nitrate

Additional work has been done by the Department of the Interior at the Pittsburgh, Pa., experiment station of the U.S.A. Bureau of Mines to determine the effect of density of ammonium nitrate upon its sensitiveness of detonation. The effectiveness of various explosives as boosters for charges of varying density is being investigated. Parallel tests are being run with ammonium sulphate and sodium chloride for the purpose of interpreting the results of tests with small lead blocks.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Technology and Economics

THE charter of the Iron and Steel Institute, which was granted in 1899, imposes a restriction as to the discussion of the practical and scientific subjects for the consideration of which it was founded. It specifically excludes "all questions connected with wages and trade regulations." During the fifty-six years which have elapsed since the establishment of the Institute, and the much shorter period since the grant of its Charter, this restriction has, with a few interesting exceptions, been very literally interpreted, as may be seen by an examination of the various papers which have been published, from time to time, in its *Proceedings*. The exceptions have been when, in his Presidential address in 1903, the late Andrew Carnegie dealt somewhat fully with these aspects of the industry, and in the Address which, as the newly-elected president, Sir Frederick Mills delivered at the Annual Meeting of the Institute held last week.

Sir Frederick spoke with a full and avowed consciousness of his transgression, for which he neither apologised, nor pleaded the ample justification the importance of his theme deserved. It is noteworthy that the Charter of the Institution of Civil Engineers contains no such clause, which is similarly lacking from the Articles of Association of the Institution of Mechanical Engineers. Members of both these institutions are free to discuss, from any and every point of view, the technical and professional subjects which engage their attention, and it is not easy to see why members of the Iron and Steel Institute should be thus debarred from discussing matters which bear so immediately, and with such special force upon the industries in which they are concerned.

Labour the Prime Factor of Cost

LABOUR is as much a raw material of industry as any of the other ingredients which go to the making of a ton of pig iron, a steel ingot, or a finished section. In the matter of cost of production by which alone the practical value of a technical process is ultimately measurable, labour is by far the predominant factor. To pure science is relegated the invaluable task of ascertaining facts, and of sorting and classifying them so that cause and effect may duly emerge in their proper and reasoned relation. The application of those facts and of the laws underlying them is the province of technology; of science as applied, by industry, to human needs. The extent to which the facts of science can be made available is limited by economic conditions; what is possible in theory is practicable only in so far as it conforms to the economic conditions prevailing at a given time.

In applied sciences, such, for example, as metallurgy there can be no divorce between technology and economics: a process, to be of any practical utility, must depend upon its being economically feasible. Apart from that criterion it possesses a purely academic interest, and is useless to trade and industry. As, therefore, the economic aspects must loom so largely in any question of industrial technology, it would seem idle to bar the gate to their discussion by those technical experts, such as members of the Iron and Steel Institute, who are so vitally interested in the issues. The American Iron and Steel Institute suffers from no such restriction of its scope. Not only questions of technique, but those relating to wages, housing, welfare, and general economics are freely discussed at its meetings, without detriment either to its prestige or its influence.

The subject of industrial fatigue is no less important to industry than that of the fatigue of metals. The Iron and Steel Institute would appear to be unduly hampered by this restriction of its activities. Its members are largely concerned with administrative work, and even those who are chemists and metallurgists have to recognise that chemical and metallurgical processes have, first and last, to depend, for commercial success, upon their being economically sound. Whether, judged from such a standpoint, they constitute an improvement on existing practice involves the taking into account of the whole of the factors concerned, and into these factors labour costs and labour conditions enter largely. It might be well if the Council of the Iron and Steel Institute could see their way to remove from their Charter a restriction so much more honoured in the breach than in the observance. The remedy for the depression at present prevailing in the iron and steel industries cannot properly be ascertained except by the fullest and freest discussion of all the factors, technical and economic, and a regulation which excludes the latter may prove, in the end, to militate against the usefulness of the Institute, and the interest attaching to its meetings.

Blast Furnace Practice and Economics

INSTANCES of the intimate relations between technology and questions of politico-social economics are not hard to find, and one of a very striking and instructive character is afforded by the action taken by the Board of the Trinec Works in Czechoslovakia recently, in respect of its ore supplies. The company possesses ample coal resources, and can produce excellent coke. The iron ores are, however, derived, of necessity, from Scandinavia, and water-borne under conditions that for seven months in the year, that is, from November to May, prevent transport. During the five months available for navigation the company has, therefore, to obtain and store its winter supplies, and for this purpose has provided storage accommodation for 300,000 tons of ore. The provision of this enormous storage capacity renders it possible properly to grade the ore to a degree of uniformity as to size, physical condition and chemical composition, that ensures the most favourable and, indeed, ideal conditions for the blast furnace working.

In these circumstances (the importance of which is not only tacitly admitted by all blast furnace men, but which appear to be the only lines upon which that "fuel economy" so often preached and so seldom practised can be achieved in the blast furnace process) the coke consumption has fallen to 15 cwt. per ton of pig iron produced. In this country the average is far higher; 25 cwt. is probably an underestimate, notwithstanding the very strict and peculiar need for "fuel economy." Grading to uniform size is only practicable when very large ore stocks are held; with day to day, and hand to hand supplies such as most British blast furnace plants depend upon, it is practically impossible.

The moral is that if British ironmasters could carry such stocks, similar methods could be adopted. So far as practice is concerned, the results would be little short of revolutionary. Furnace lines, charge distribution, rate of driving, temperature of blast—a whole host of essentially technical problems would present themselves for solution. The connection here between technology and social economics is direct and obvious. Groups of British blast furnaces, working on similar ores in a given district, for example, Middlesbrough, or North Lincolnshire, could effect such economies if they pooled their resources, bought ore in common, and stored and handled it in common, instead of separately and in small units. The vastly larger stocks, dumped more economically in common stores; analysed more economically in common laboratories, handled more economically by automatic machinery owned and employed in common, would enable each works in the group to obtain just that kind of uniform and consistent grade of ore which, in the blast furnace, would "save" the much-needed fuel. "Pooling" resources, and buying in common are purely industrial questions; the results are purely technical, and the cause cannot legitimately be divorced from the effect. In any really "scientifically" managed works ample liaison is regarded as essential between the technical, the administrative, and the commercial staffs. The value of such liaison is recognised freely, and what tends to efficiency in a given works will tend to similar efficiency in a group of works, and eventually, in a whole industry. There appears to be no machinery in this country by means of which such questions can be seriously and dispassionately threshed out, both in their technical *and* their economic aspects.

Salt Water Corrosion of Metals

THE serious financial losses which occur as a result of the corrosion of the metal equipment utilised in the petroleum and natural gas industries have been the object of a special investigation by the United States Bureau of Mines. That

the matter is causing considerable concern may be gathered from the statement that the corrosion is so rapid and entails so great a waste of resources that operations in many important fields cannot continue to be conducted on a profitable basis unless the losses from this source can be eliminated or at least considerably reduced.

The magnitude of this destruction of metal equipment due to corrosion is proved by the huge consumption of iron and steel pipe, tubing, casing, pump valves, etc., to replace worn-out equipment, and by the amount of such equipment that is left in wells or scrapped. This destruction of equipment constitutes in itself a serious waste, but contingent production troubles, such as underground leakage of oil through defective tubing and pumps, frequent and costly repairs with necessary suspension of production, and the ultimate injury to or loss of valuable wells, often absorb all operating profits.

It is the salt water in the wells and in the strata through which the wells are drilled that is responsible for the extremely rapid corrosion in oil and gas fields. Corrosion of equipment is caused principally by electrolytic action which is analogous to the action in the well-known galvanic battery. The different strings of pipe, and the pumping equipment immersed in salt water in the oil well are in effect the electrodes in a huge galvanic battery. Different metals and different pieces of the same kind of metal, and even different points in the same piece of unhomogeneous metal, constitute the positive and negative electrodes in the galvanic couples, whereas the salt waters with their dissolved salts and gases constitute the electrolytes. Under these conditions the electro-positive surface from which the current passes from the metal into the salt water is the one that suffers corrosion. The main problem confronting the petroleum engineer is to eliminate this galvanic action or to control it so that it will not injure the metal equipment.

Conditions Favourable to Corrosion

ALTHOUGH corrosion must be regarded as a water trouble, it is also recognised that not all ground waters are corrosive. In general, neutral saline waters, acid waters, and waters whose dissolved constituents break down or hydrolise readily to yield acids are corrosive in the sense that they either induce corrosion or afford conditions favourable to its occurrence, whereas most strongly alkaline waters are noncorrosive. Waters that contain magnesium chloride are especially corrosive, whereas those that contain sodium carbonate are generally non-corrosive under oil and gas well conditions. Waters that are non-corrosive in oil and gas wells may be highly corrosive when exposed to the atmosphere. The fact that noteworthy corrosion does not always occur in wells yielding corrosive waters but does sometimes occur in strongly alkaline waters, especially those charged with hydrogen sulphide gas, does not invalidate these general rules. Local conditions in the wells affect the irregular occurrence of corrosion.

Certain gases absorbed in water influence corrosion. This is especially true of carbonic acid gas and gaseous sulphur compounds, more especially hydrogen sulphide. Hydrogen sulphide absorbed in corrosive waters, or even in alkaline waters that otherwise could not be corrosive, causes especially rapid corrosion of iron and steel equipment in oil and gas wells; the end products are usually mixtures of ferrous sulphide with other ferrous compounds.

The processes of corrosion in oil and gas wells are self-stimulating, the products of corrosion forming mud-like masses which are in themselves electro-negative to iron, thus setting up new galvanic couples with the iron and steel equipment. The destruction of the equipment thus becomes more and more rapid as the corrosion progresses. Although much progress has been made in preventing the corrosion of metals, the need for reducing the damage from corrosion in oil and gas fields is still imperative. This is especially true of underground corrosion in the wells, because underground conditions favour corrosion and are difficult to study; hence they have not been thoroughly understood. In efforts to stop damage to oil and gas field equipment by corrosion, numerous methods have been proposed or tried with varying success. Some of these methods are cheap and effective. It is surprising, however, that in many important fields the damage by corrosion is accepted as necessary or unavoidable, although cheap and effective methods have been developed and successfully tried which greatly reduce or eliminate the trouble.

X-Ray Testing in Foundry Practice

CURRENT methods of testing (according to a note in the Bulletin of the British Cast Iron Research Association) have the great defect that they involve destruction of the material and hence must be applied to test bars and not to the castings themselves. Nevertheless, the greatest difficulties with which the founder has to contend—draws, shrinkages, and blow holes—are concealed in the casting, and on theoretical grounds the most suitable test would be one which did not involve the destruction of the casting, such as X-rays. It is, however, impracticable to apply X-ray testing as a routine method, but it is possible that in planning composition, melting, and moulding methods for a new type of casting, especially for mass production work, great use might be made of X-rays in the preliminary stages of the work to ascertain whether the methods adopted are producing sound castings. It is argued that defects of a similar character may occur continuously if the methods adopted are wrong and that the X-ray may afford opportunities of correcting defects and thus avoid trouble before production is commenced. Sample or pilot castings are made and tested in all ways, including X-ray testing, before the methods of production are finally determined. It is unlikely that any single company would be able to put down an elaborate plant for this purpose, but the Department of Radiological Research in the Research Department at Woolwich Arsenal has already gained several years' experience in X-ray testing applying both to metallurgical and other products, and there is little doubt that co-operation between the Research Association and this Department and with the National Physical Laboratory could be arranged if desired. At the present time the limit of penetration achieved in the United States is 3 to 4 inches.

A New Flotation Reagent

INTERESTING results have been obtained from tonnage scale tests on zinc-iron middlings, badly oxidised, taken from old dumps remaining from former operations at Notre Dame des Anges in the Province of Quebec. A 50 per cent. zinc concentrate with a tailing content of less than 1 per cent. zinc was made from this material. In securing this remarkable result a new flotation reagent, potassium xanthate, was used, it is believed, for the first time in this class of work. Large scale tonnage tests on run of mine ore from Notre Dame des Anges showed that by tabling and flotation 80 per cent. of the lead values should be recovered in a high grade lead concentrate containing 55 to 70 per cent. lead. The gold and silver values in the ore are practically all recovered in the lead concentrate. The zinc recovery is high and 90 per cent. can be expected with a grade of concentrate assaying 43 to 45 per cent. zinc. By a second method of selective flotation a 50 per cent. lead concentrate can be obtained with a 90 per cent. recovery of the lead values, 95 per cent. of the gold and 97 per cent. of the silver; a 50 per cent. zinc concentrate can also be obtained having a lead content of less than 1·5 per cent. and with a recovery of better than 90 per cent. of the zinc values. A mill is now being built the flow sheet of which is based on the methods followed in these tests.

Copies of the complete memorandum may be obtained on application to the Office of the High Commissioner for Canada, Kinnaird House, Pall Mall East, London, S.W.1.

Lead and Zinc in Eastern Canada

THE Provinces of Ontario and Quebec in 1924 produced about 7,000,000 pounds of lead, of which 6,000,000 pounds was pig lead—the balance contained in concentrates exported, and about 3,000,000 pounds of zinc all contained in concentrates exported. The steady advance in the price of lead and zinc during the past five years has resulted in an active search for deposits of these metals and in the re-examination of properties formerly worked. The successful application of the flotation method of concentration to some of the complex lead zinc ores will permit the more profitable operation of some of these deposits, and an increased production of these metals in Eastern Canada may be anticipated.

A memorandum by Mr. C. S. Parsons, mining engineer, gives the results of some recent Mines Branch experiments on the production and selective flotation of marketable lead and zinc products with high recoveries of values.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

THE best commentary on the iron and steel trade for the month of May is given by a headline which appeared in a London newspaper last Saturday: "Steel works closed: More Furnaces Out." That expresses briefly but forcibly the tendency of the trade during the past month. The general report from all quarters is that business is slacker than it was a month ago. This is not merely a report; it is a fact which, if there were no other evidence, finds ample corroboration in the frantic efforts which are made by the works, in competition with each other, to secure any offers that come into the market. Price cutting is carried on recklessly, so much so that the buyer is in a position to dictate his own terms. In fuel, in pig iron, and in iron and steel the demand lags behind the supply, and the margin can be prevented from widening only by the closing down of furnaces and mills.

It is not surprising then to read the newspaper report to which we have just referred. The Barrow Steel Co. announce that they are closing down the whole of their plant at the iron and steel works, excepting the hoop mill. The reason given is the lack of trade. If this kind of thing continues we shall nullify the large increase in plant which was made during the war and shortly afterwards, and find ourselves with a pre-war capacity to deal with a demand which is no better than pre-war and which is faced with obstacles which did not exist in 1914. The outlook is far from bright, and one cannot see any signs of the clouds lifting.

There is a report that other steel works are contemplating the same step as the Barrow Co. have taken, to close down until trade conditions give some hope of remunerative working. Such a course means great distress for the district in which the works are situated. The example of Jarrow-on-Tyne is one which we do not want repeating. Yet, speaking for the industry as a whole, it might be better for the available trade to be concentrated in the works which are best fitted to produce economically, and do away, as much as possible, with this suicidal price-cutting.

Downward Trend of Prices

As may be expected, the trend of prices is downwards, and in almost every section prices are lower than they were a month ago. It is true that in many cases the official prices remain the same, but so-called official prices are nothing to go by, and the manufacturer who attempts to adhere to them often finds himself without orders. There are instances where some stout-hearted maker determines to abide by the prices fixed by his Association, but sooner or later he has to abandon his ideal, and either shut up his works or join in the competition that is rampant. Those works are fortunate which, by reason of the quality of their product, can command a price which is not at the mercy of the open market.

The demand for guaranteed quality in steel is much more insistent than it used to be—another outcome of the war. Test specifications accompany nearly every order that is given out, and while this means additional cost to the steel maker who maintains his quality and seeks to satisfy his customer in every way, it is by no means easy to obtain any advantage in price, for the simple reason that there are so many works ready and willing to take the risk of the quality at a lower price. There is no doubt that large quantities of foreign steel are being sold in this country as British steel, and there is an extensive trade in "seconds" billets, which when they have passed into the finished product in the re-rollers' works are sent out as first-class quality. So the game goes on—cutting in quality and cutting in price, and one wonders what the end of it will be.

We are quite definitely of opinion that this price cutting, as we have said before, is not for the good of the trade. It does not add to the volume of business, and it merely intensifies competition. There is always someone, either with superior resources or greater recklessness, who will undercuote the lowest price hitherto known. Soon this cut price becomes the market level, and the buyer is left in doubt whether to place his order or insist on further reductions. This process must come to an end some time, but how soon or how long it is impossible to foretell. Months ago it was thought that pig iron prices had really reached the bottom and that no further reductions were possible, but prices have gone steadily downwards since then. The sequel is the increasing number of furnaces that are being blown out.

The Political Situation

The political situation is having its effect on the iron and steel trade, along with the other industries. The return to the gold standard is causing some anxiety, as it is realised that the possible results of that measure are an increase in the depression which already exists, a further fall in prices, and more trouble with the Unions owing to the reductions in wages which will inevitably follow.

One of the large steel firms has just issued a statement showing the comparative cost of railway carriage in the production of steel before the war and to-day. The increase is about 10s. per ton on the finished product. In view of the high wages being paid to railway workers in comparison with other industries, it seems that the steel trade is being unduly penalised in order to provide these high wages. Local rating is also a serious item in cost, being four or five times as much as it was pre-war. Here again wages are being paid to municipal workers which are out of all reason when compared with those which skilled men in the iron and steel trades are able to obtain. There is urgent need for economy in the Government and municipal departments, so that expenditure may be reduced and industry relieved of some of the heavy burden it is carrying.

Safeguarding for the Steel Trade

Active steps are being taken to obtain the benefit of the Safeguarding of Industries Act for the steel trade. An application to the Board of Trade is in course of preparation. There is indeed a very strong case to be made out, particularly in regard to the semi-finished steel which is imported from Belgium, France, and Germany. Taking last year's figures, it is estimated that if this class of imports had been made in this country it would have found employment for 50,000 men for the year. Sir Frederick Mills, in his presidential address to the Iron and Steel Institute, referred to the desirability of special legislation being introduced to enable the steel makers to meet the unfair competition from abroad.

The coal trade is now experiencing in full measure the depression which the steel trade has suffered so long. One colliery after another is having to close down for want of orders; and those which are working find the utmost difficulty in selling their full output. Coal and coke for prompt delivery can be purchased at almost any price. The steel maker cannot be blamed for taking full advantage of this situation, as he has had to pay through the nose for fuel for quite a long time.

Business in pig iron is limited; as a general rule it is only immediate requirements that are being satisfied. Forward sales are very infrequent, and consumers are trying hard for still lower prices. There is still some amount of bearing the market by the speculative merchants. In addition to the Barrow furnaces, the Millom Co. have closed down two furnaces. Hematite is just as weak as foundry iron. The demand is very poor, and the steel maker who is ready to buy can practically name his own price. Finished iron is practically stagnant.

There is nothing exceptional to report in semi-finished and finished steel. There has been some talk of a better demand for structural steel, but it seems to be chiefly talk. The billet trade is slack; continental supplies are still coming in at about £1 per ton less than the home price. The demand for sections is no worse, but prices are at a very low level. Steel bars are considerably weaker, and competition in this branch has become very acute. There is not much difference now between the re-rollers' price and that of the steel maker. The state of the market for steel plates is reflected in the prices quoted. Nominally the basis is £9 5s. per ton, but £9 2s. 6d. is freely quoted, and orders are accepted fairly readily at £9. Indeed, we have heard of one large plate maker who advised a customer not to buy much even at £9, as still lower prices were likely to come soon.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Recovering Metals from Wastes

ACCORDING to a patent application by Cuivre Natif, of Paris, waste materials such as slags, workshop sweepings, waste slimes from concentrating tables, are treated for the recovery of the metals. Such materials may contain free copper, zinc, iron or nickel, or their silicates, and are treated with sulphuric acid and fluorspar, and a little nitrate or nitric acid. The metals are then precipitated, *e.g.*, with iron or zinc, or recovered by electrolysis. See patent application 230,471, having the International Convention date, March 7, 1924.

Alloys

A PATENT has been applied for by Metallbank und Metallurgische Ges. Akt.-Ges., of Frankfort-on-Main, Germany, for an alloy of lead, sodium and/or potassium, suitable for bearings. The alloy may contain up to 0·8 per cent. of sodium and potassium, up to 0·1 per cent. of lithium, and up to 5 per cent. of copper, nickel, cobalt, zinc, magnesium, strontium, calcium, mercury, phosphorus or sulphur. See patent application 230,827, having the International Convention date, March 12, 1924.

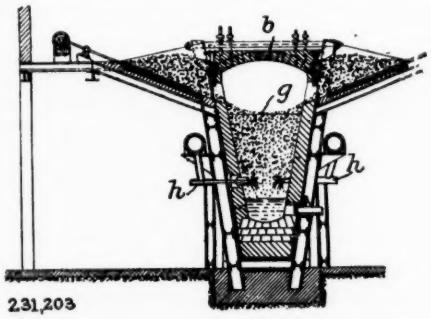
AN alloy which offers considerable resistance to oxidation and scaling at high temperatures, and to attack by flame or hot gas and which also possesses great strength and toughness at high temperatures, has been patented by Sir Robert A. Hadfield. The alloy contains besides iron, carbon up to 1 per cent., manganese, 0·4 to 8 per cent., chromium 8 to 25 per cent., nickel 5 to 17 per cent., silicon 0·7 to 10 per cent. Tungsten or molybdenum 1 to 10 per cent. may also be added. See Patent No. 232,656, dated April 27, 1925.

Refractory Metals

IN a process for the extraction of uranium, thorium, and zirconium, by Westinghouse Lamp Co., of Bloomfield, N.J., U.S.A., a halide of the metal and a reducing agent of low boiling point such as magnesium, are heated in a vacuum till the salt is reduced. In an example, a mixture of uranyl acetate, potassium or sodium fluoride, hydrofluoric acid and formic acid, is exposed to sunlight or ultra-violet light to obtain a double fluoride of uranium and potassium. The precipitate is fused with potassium and sodium chlorides, washed, dried, mixed with magnesium or magnesium-calcium alloy, and reduced in a molybdenum or other crucible. See patent application 230,865, having the International Convention date, March 17, 1924.

Metallurgical Furnaces

IN a new metallurgical and chemical high temperature furnace by A. Helfenstein and Helfenstein Elektro-Ofen Ges. of Vienna, the material is fed downwards into the furnace



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at the sides so that it forms a trough *g*, and thus a high-temperature chamber below the arch *b*. The material passes downwards over the furnace walls and protects them, while it is itself preheated. Fuel and air are fed in through tuyeres *h*, and combustion takes place above the trough *g*. See Patent application 231,203, having the International Convention date, March 24, 1924.

Extracting Tin

IN an invention for recovering tin from tin scrap by T. Rondelli, of London, the difficulties involved in the use of tin tetrachloride as a solvent in the known process are avoided by employing carbon tetrachloride and chlorine. Carbon tetrachloride has the advantage of being cheap, non-combustible, and non-poisonous with a low specific heat and boiling point, so that the subsequent distillation can be readily effected. It is not necessary that the materials should be quite dry as in the case of tin tetrachloride, and the preliminary washing can be dispensed with as carbon tetrachloride is a solvent of grease. The tin scrap can be treated by a solution of chlorine in carbon tetrachloride, or chlorine may be passed into the solvent which is in contact with the tin scrap. The tin only is attacked if not much water is present, and the operation may be effected in iron containers. The product may be distilled to recover the carbon tetrachloride, leaving pure tin chloride, or the mixture may be distilled upon lime or soda which avoids the distillation of any tin chloride with the solvent. Alternatively the solution may be agitated with water, which extracts the tin chloride as an aqueous solution in a separate layer. The process may also be applied to the extraction of tin from a reduced tin ore. The process is described in detail in Patent No. 232,281, dated November 15, 1923.

Treating Copper Ores

ACCORDING to a patent by T. J. Taplin, junr., W. G. Perkins, and Metals Production, Ltd., of London, the leaching of copper ores with ammoniacal solution is facilitated by heating the ore in a reducing gas at a temperature too low to melt or alloy the copper or frit the gangue, *e.g.*, 400° C. The ore is then allowed to cool in a reducing atmosphere to 100° C. while passing through a rotating tubular conveyor, and then leached. See Patent No. 233,029, dated January 29, 1924.

Detecting Axle Flaws

A NEW method of detecting flaws in the axles of heavy vehicles of transport was described on Thursday, May 28, by Mr. J. K. Bruce (acting general manager to London County Council Tramways), who lectured at the London School of Economics, Aldwych. "Sooner or later," he declared, alluding to tramcars, "incipient flaws occur in the axles which are invisible to the naked eye. If neglected the flaws deepen until the axle breaks. This problem has been occupying the minds of engineers for many years. The London County Council's tramways undertaking has now adopted a method by which these flaws can be detected. It is a very important discovery, and has great possibilities. The axle is magnetised and a solution of iron and paraffin is poured on the places where these minute hair-cracks are likely to occur. The particles of iron cling to the cracks and reveal to us what would otherwise remain undetected. This discovery is of the utmost value to transport concerns, and railway companies are now adopting it." Mr. Bruce also mentioned that the wear of rails was one of the most important problems the tramway undertakings had to consider, and experiments were in progress on rails of varying composition with the object of finding a type with a longer lease of life.

Importance of Coal Research

MR. C. A. SEYLER, Swansea borough analyst, recently returned from America, where he was the sole British chemistry delegate at an important conference. He lectured in New York, Washington and Pittsburg on his classification of the coals of Britain, Belgium, France and Germany, and on the microphotography of coal. In an interview, he said that "the days when the best coals were very cheap and could be used in the crudest way were gone. Coal costs are now so high that they are a real burden upon industry, and that was why investigations into the use of every particle of power in coal were so important to industry." He is optimistic of the result of further study of the microscopy of coal.

One of his strongest impressions had been the wonderfu application of scientific methods to industry in the States.

With minor matters still to settle, he had arranged a new nomenclature which would unite the American and the British coal classification. His classification had enabled Koppers, of Pittsburg, one of the biggest coke companies in the world, to detect errors in analysis and even to know the yield of by-products they would secure from a given coal.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALUMINIUM.—Surface treatment of metals with aluminium. J. F. Kayser. *Metallurgist*, March 27, 1925, pp. 34–37. Describes the formation and properties of "aluminium-ised" surfaces.

Corrosion phenomena in aluminium. E. Maas and W. Wiederholt. *Z. Metallkunde*, April, 1925, pp. 115–121 (in German). Discusses the action of acids, bases and salt solutions on aluminium plate.

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Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

BARRONIA METALS CO., LTD., London, S.W.—Registered April 7, £1,500 (not ex.) mort., to Bank; charged on 59, Parsons Green Lane, S.W.; also registered April 7, Land Registry charge to Bank; charged on property comprised in title 294921.

KRYN AND LAHY METAL WORKS, LTD., London, E.C.—Registered April 16, £2,000 mort. to Mrs. E. B. Macfadyen, Bramblebank, Alington Lane, Letchworth; charged on The Coppice, Letchworth. *£25,000. December 31, 1924.

NEWTON (FRANCIS) AND SONS, LTD., Sheffield, iron-founders.—Registered May 2, £7,000 debs.; general charge. *£5,500. April 17, 1925.

SANDERSON BROTHERS AND NEWBOULD, LTD. (late SANDERSON BROTHERS AND CO., LTD.), Sheffield, steel manufacturers.—Registered May 5, charge, to Bank; charged on property at Sheffield. *£100,000. May 9, 1924.

UNITED STEEL COMPANIES, LTD., Sheffield.—Registered May 5 (by order on terms), general conveyance and assignment of hereditaments and other assets of Workington Iron and Steel Co., Ltd. (in liquidation) (supplemental to Trust Deed dated April 19, 1918, securing £1,000,000 B deb. stock); charged on properties, etc., comprised in schedules to the particulars filed. *£2,410,898 debs. and £243,998 6s. 9d. mort. November 3, 1924.

A Study of Vapour Pressures

THE results of a study of vapour pressures of the common metallic chlorides and a static method for high temperatures are given in technical paper 360, by C. G. Maier, associate metallurgist, issued by the Department of the Interior through the Bureau of Mines. The work described in this pamphlet was undertaken primarily to furnish technical data on the vapour pressures and heats of vaporisation of the metallic chlorides at high temperatures. The study of the fundamentals of certain important metallurgical processes dealing with chlorides at high temperatures is difficult, especially the chloridising roast and chloride volatilisation. One important reason for the difficulty is the almost complete lack of vapour pressure and thermal data that are technically usable. Such data are not only necessary to understand losses or vaporisation of metals as chlorides, but they are essential to deal quantitatively with the chemical reactions that occur in the processes mentioned above.

A method used for the determination of the vapour pressures of the common metallic chlorides, developed in the course of co-operative work between the department of metallurgical research of the University of Utah and the Salt Lake City Experiment Station of the Bureau of Mines, is described in this technical paper. By this method many points of the vapour-pressure curve can be found during the course of a single satisfactory experiment. Under the method described in the paper vapour pressures up to 1,250 deg. C. can be determined. The method is static and direct, and involves no assumptions relative to the behaviour of the vapour according to the gas law. The vapour pressures of the commoner metallic chlorides have been determined over this range. Available data on the vapour pressures and decomposition pressures of nearly all common metallic chlorides have been assembled. Boiling points of the common metallic chlorides are given as well as heats of vaporisation of the common metallic chlorides as calculated from vapour-pressure.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

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China Clay: Retrospect and Prospect

THE beginning of the year is an opportune time for reviewing trade in the past year and for analysing such indications as are available as to the prospects of trade in the coming year.

One satisfactory feature of the past year has been the increased tonnage of China Clay and China stone dealt with by the China Clay industry, for the first time since the slump year of 1921 drawing practically level with the post-war boom year of 1920, when 864,369 tons were despatched. But the monetary values of the deliveries made last year have fallen very considerably below the value of those despatched in 1920, when prices reached their most profitable level at an average of £2 18s. 6d. per ton. That year was also noteworthy for the fact that for the first such period in its history the total value of the products' turnover was over £2,524,000. The industry's best pre-war year was 1912, when 934,000 tons were despatched, to the value of £1,053,000.

The Problem of Over-production

Following that record year for quantity, when demand was almost equal to the supply, there was a boom in the opening up and development of new properties and the extension of old China Clay works which, having reached the production stage since the war, have swollen the volume of China Clay produced considerably in excess of what, up to now, it has been possible for the markets of the world to absorb. The extra production of common clays has been in very much greater ratio than that of the best clays, the deposits of which are limited in extent and productivity. It was to stabilise the industry towards the end of the war and since to meet this situation of over-production for the restricted markets available due to war conditions, that the Association, which came to an abrupt end in September, 1924, was formed at the end of 1917. Consequent upon this, to many producers, regrettable event, buyers have not been slow to take advantage of unrestricted competition among the producers to secure deliveries of large quantities of clay at unremunerative prices. This factor has contributed very largely to the increase in tonnage dealt with since the fall of the year, and may affect the demands in the early part of this year now that there is a tendency for prices to harden slightly.

Need for Co-operation

That the producers are feeling the loss of their Association, which not only arranged prices on a reasonably profitable basis but standardised the different grades of clays according to quality and the purposes for which they were to be used, is seen in the remarks we publish elsewhere of Mr. W. Rose, who has addressed himself to a consideration of the position, immediate and future, of the trade if the present price-cutting policy continues. If it could be shown that the ultimate purchaser of the commodities into the manufacture of which China Clay enters was buying them at a less price, something could be said for the sacrifices the China Clay producers are making: but seeing that they are only helping to swell the profits of other people, it is a foolish policy for the producers to cripple themselves in the process. The omens point to the evolution, in course of time, of an organisation which will effectively safeguard the interests of the China Clay producers, so that those engaged in the production of this valuable raw material shall receive a fair return for the products of their labours. There need be no fear on the part of middlemen buyers and consumers of China Clay that the producers will ever be led into fixing prices that will produce inordinate profits, because they are very much alive to the competition of foreign clays in the export markets and are not likely to fix prices at such a level as will allow foreign clays to oust the home product, or prevent them from recovering those pre-war markets lost through the war, the gaining of which during this year, especially in European markets, is more promising than has been the case for the last two or three years.

Export Trade Prospects

The Dawes plan for the settlement of reparations is producing a much more stable state of affairs in business circles on the Continent and is having a favourable effect upon the export trade. Through the steadying effect it has had and is having upon exchanges, China Clay business during this year looks like being transacted on more advantageous terms than has been the case since the war, the fluctuation in the exchanges having operated favourably to foreign countries and the development of their domestic clay markets to the detriment of our markets. In future the home trade will be able to deal more effectively with the competition of Czecho-Slovakian clays, particularly in the German, Belgian and French markets.

With the recovery and development of overseas markets, coupled with widespread dissemination of information as to new issues, and the development of colloidal clay (a highly refined essence derived from ordinary China Clay), signs point to 1925 being a "bumper" year as regards tonnage and, we hope, if the wisdom of co-operation prevails among the producers, the most prosperous one since the war.

China Clay for U.S.A.

ACCORDING to a United States China Clay authority, American producers anticipate greatly increased imports as a result of the dissolution of the association of producers in Great Britain. It is understood that the British producers are engaged in a price war. In the course of the competitive struggle, which, according to the United States opinion, has as its objective the elimination of some of the British producers, it is feared that large contracts will be made in America at less than the cost of production. The U.S. Tariff Commission is making a survey of the situation, and it is probable that legislation will be offered at the forthcoming session of Congress proposing higher rates of duty on both crude and China Clays. The existing law carries a duty of $2.50 per ton on kaolin and $1 per ton on unwrought or unmanufactured clays.

Round the Cornish China Clay Works

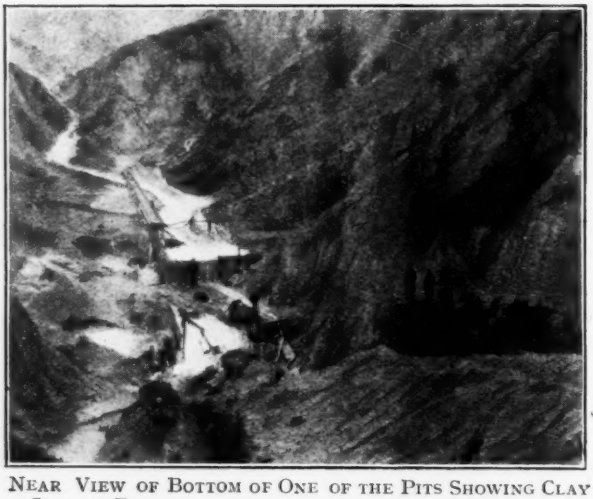
II.—Rosevear and Imperial Goonbarrow

THERE is no name better known in the West of England China Clay industry than that of Dyer, bearers of it having been the pioneers of the industry in the far-off days when China Clay producers themselves actually delved in the pits.

The Dyer tradition in connection with the industry is being carried on to-day by "Captain" Samuel J. Dyer and members of his family, whose forebear, "Captain" Samuel Dyer—the present "head's" father—was the founder of the firm, and was among the pioneers who discovered the value of China Clay as a raw material, and were prominently associated with its initial development.

"Captain" Samuel Dyer

The present "Captain" Samuel J. Dyer, who retains the title he gained when he acted as manager of China Clay works under his father, is essentially a China Clay producer, and knows all there is to know of the production of China Clay. It was mainly due to the manner in which the late "Captain" Samuel Dyer realised the potentialities of the China Clay lands owned by the Lamb Estate, that he was appointed the agent, an appointment which, in the nature of things, naturally



NEAR VIEW OF BOTTOM OF ONE OF THE PITS SHOWING CLAY STREAM PREPARATORY TO BEING PUMPED TO SURFACE.

passed to the present "Captain" Samuel J. Dyer. It is also natural that most of the works with which "Captain" Dyer is associated have been developed on the Lamb Estate. Another fact of interest is that all the companies with which "Captain" Dyer is associated, possess rich beds of clay of every quality required by paper makers, potters, cotton mills, and chemical works.

Five Works Controlled

Besides being joint manager of Trethowel and Hallivet China Clay works, "Captain" Dyer controls, either as manager or managing director, Rosevear Clays, Ltd., a very old-established works in the neighbourhood of Bugle; Imperial Goonbarrow Clays, Ltd., another old-established works now undergoing considerable new developments; Great Treviscoe Clays, Ltd., and Central Treviscoe China Clay Co., in the well-known China Clay area of St. Stephens; and the Gears China Clay Co. All are being worked on the most economical lines, the practice being to use the natural advantages of the works to the fullest extent, coupled with the most serviceable machinery, in order to produce clays to sell at the lowest possible price, consistent with production costs.

Rosevear Works

The Rosevear China Clay Works have been managed by "Captain" Dyer's family for very many years on behalf of Singleton Birch and Sons, Ltd., who carried on a very extensive merchanting business. In 1922 when W. Singleton Birch and Sons relinquished their China Clay producing business, the Rosevear works were acquired by "Captain" Dyer and his friends, a limited liability company under the title of Rosevear Clays, Ltd., being formed. "Captain" Dyer and his father had been responsible for the development of Rosevear works for fifty years, and in taking over the works he was thoroughly familiar with every characteristic and, therefore, well qualified to develop it successfully. That he has done so is seen by the record of progress since.

Paper-making Clay

The sett belonging to the Rosevear works is between 30 and 40 acres in extent, the whole of which has been tested with very satisfactory results. The present pit is being worked in a very productive bed of clay of a quality well known in the paper-making trade as a good medium paper-making clay. This clay has been going into the American market for the last thirty years. It is very finely washed, the overburden is very light, and the clay, being of a soft nature, can be practically all washed with the hose. There is a very fine kiln which is 300 ft. long, capable of drying 10,000 to 12,000 tons a year, and of storing up to 2,000 tons of clay. The railway comes in alongside, giving the works every facility for rapid transportation.

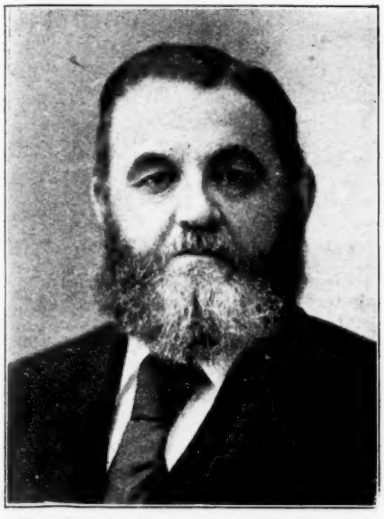
Imperial Goonbarrow

The Imperial Goonbarrow China Clay Works, the most recent acquisition by "Captain" Dyer, is well known and was for many years owned and worked by Mr. J. H. Knight, of Par, who recently retired from the business. At the beginning of 1924 "Captain" Dyer formed a private company, under the title of the Imperial Goonbarrow Clays, Ltd., to work the sett, and had no difficulty in securing all the capital required—the works and himself as a manager, being well known. "Captain" Dyer is the managing director of the company, and his son, Mr. Percy Dyer, an energetic young man who is following in his father's footsteps as an authority on China Clay production, is the secretary. Since the works have come into his possession, "Captain" Dyer has been carrying out extensive developments, as a result of which large quantities of best bleaching and paper-making clays are now being produced.

The pit is 20 fathoms deep, and it has been proved that the clay goes down to a further depth of 40 fathoms. The area of the pit at the bottom is between three and four acres, practically all best clay. There is also the advantage of there not being any iron oxide veins in the pit—the bugbear of China Clay producers, which, of course, means that a clean clay can be produced.

The company has been reconstructing the machinery and bringing it up to date, so that the works will be capable of producing up to 10,000 tons per annum. The tanks and the

TANKS OF WET CLAY AT REAR OF KILN READY FOR DRYING.



THE LATE "CAPTAIN" SAMUEL DYER.

"CAPTAIN" SAMUEL J. DYER.

MR. PERCY DYER.

kiln equipment are capable of dealing with this tonnage. The railway comes alongside the kiln, and a cargo of clay can be shipped at very short notice. Under "Captain" Dyer's supervision there is a bright future for these works, the fact that they produce the best clays being a great advantage.

Treviscoe Works

"Captain" Dyer's other works, Great Treviscoe and Central Treviscoe, are producers of potting clays of medium and best qualities, much favoured by potters. These clays are of a somewhat different character from those at Imperial and Rosevear works, and not so easy to produce. The necessity of differentiating in the description of clays, whether, for example, they are bleaching or potting clays, is seen in the fact that potting clays are not suitable for paper making and bleaching, and *vice versa*, generally speaking, paper and bleaching clays are not suitable for potting. At Gears China Clay Works, a common clay is produced suitable for the cheaper lines of pottery and paper.

Machinery Test

The test applied by "Captain" Dyer to any proposal for the installation of new machinery is whether it will do the work better and more economically than existing machinery and equipment. If he is convinced of this he has no hesitation in introducing new plant, always making a point of utilising advantages provided by nature in an ample supply of water, gravitated to the points at which it is required for washing, and also in the conveyance of the clay in the liquid state.

The fact that most of the works with which "Captain" Dyer is associated have prospered is a testimony to the ability of the management and the economical policy pursued in development and production work. In the sales and office organisation, necessary for the carrying on of so many works, "Captain" Dyer is ably assisted by his son Percy.

China Clay Crisis: The Economic Position

By "Economist"

THE crisis that has arisen in the China Clay industry is interesting and raises important economic questions. As far as local phases of the crisis I have no desire to meddle, but it appears desirable to call attention to precisely similar crises that are arising in other industries.

It may not be generally known that about fifty soap firms are in combination. The same applies to matches and other things. Each firm carries on under its old name and reputation as a distinct firm. It may be taken for granted that there is a real desire to raise the standard of living of wage earners. The difficulty is to do this and maintain profits at such a level as to attract capital and meet foreign competition. Those engaged in unsheltered industries insist upon low prices; in other words they decline to aid in raising the standard of life by any contribution on their part. The relation of wages, profits, and prices is an intricate problem.

If we consider the three industries, coal, agriculture, and clay, we find in each great inequalities of value, which limit profits and wages whilst prices are determined by world competition. In agriculture profits are supposed to be measured by those payable on the least fertile lands on the margin of cultivation and in the coal industry by those on the worst seams worked. The same law holds in regard to clay. What the result is may be seen at the present time in the coal industry.

The State has supported the demand for the fixation of "a minimum wage." Since the entry of the State in this direction during the war a constant fight has been in process between the Miners' Federation and the coal owners. At last the climax has come in a recent settlement insisted on for a universal minimum, which the collieries on the margin of profit cannot pay, as they warned the Federation at the time of settlement. In the clay industry the same thing is happening. Clearly the wages which the more profitable units of the combination can pay cannot be paid by the rest so long as prices are cut. It is foreign competition that cuts prices because the cost of production abroad is lower than here. In other words cheapness of commodities is the barrier to a raised standard of living.

It is a remarkable fact that clay as a raw material goes to Germany, and is there manufactured into earthenware, while the common clay sent there is made into brick, and returned to this country as commodities fully manufactured and delivered after a double journey at less cost than we can produce them. The public object to any attempt to keep up prices, but they fail to see that to keep up doles more than balances the differences in prices whilst demoralising the workers. The coal mines that cannot pay the wages fixed in the last settlement are either closed or have given notice to close down in the following areas: South Wales, Bristol, Dean Forest, Cumberland, Durham and Kent. Thousands of miners are already on the dole. Only one conclusion can be arrived at; either wages must fall or prices must rise if the standard of life is to be maintained in unsheltered industries.

American Paper Exposition Postponed

A CHANGE in the date of the annual meeting of the American Paper and Pulp Association prevents the Paper Industries Exposition being held at Grand Central Palace, N.Y. in February, 1925. No other building being available to accommodate paper making machinery, it becomes necessary to defer holding the Third Paper Industries Exposition to 1926. In that year it is hoped that an exposition worthy of the industry will be held at the same time as the annual Convention.

G.W.R. and Fowey

Effective Traffic Speed-up at Jetties

THE new system for the regulation and control of China Clay traffic at the G.W.R. jetties at Fowey is proving very successful in the speeding up of loading and the cutting out of preventable delays after vessels are in their loading berths. After eight weeks' experience, the China Clay producers, who had been pressing for improved organisation at Fowey, are delighted at the greater expedition that is manifest as a result of the new system of control.

Until the beginning of November, Mr. Glasson, the station-master, who has had over 14 years' experience with China Clay traffic at Fowey, divided his duties between the routine work at the station and a general supervision of the work at the jetties. Obviously under such conditions it was impossible for Mr. Glasson to give his undivided attention to the jetties, where continuous supervision was necessary to ensure the maximum of despatch. Since Mr. Glasson was appointed Quay Superintendent at the beginning of November, with an assistant station-master to attend to detail work at the station, he has been able to devote adequate time to the management of the clay traffic at the jetties. It is his duty to see that vessels are loaded in the shortest possible time after they take up their berths. To do this he has to keep in closest touch with St. Blazey, the China Clay clearing station for the bulk of the China Clay coming from the Cornish works to Fowey, in constant communication with the China Clay works responsible for the sending of cargoes for the ships being loaded, and has to see that the clay is available when the different compartments of the vessel are ready to take them in.

The organisation and constant supervision necessary to ensure the successful accomplishment of these various stages will be realised when it is pointed out that few vessels of large tonnage take in a single cargo of one class of clay from one works only, the cargo being generally made up of anything from five to twenty different lots from different firms. Bulkheads have to be built up to separate the different lots, and the quay superintendent has to see that the different cargoes are at the jetties ready to be loaded in turn.

It sometimes happens that a cargo planned to take a certain position in the vessel is not at the jetties when required through the works not sending it on to time, but it may happen that a cargo from another works planned to occupy a posision higher up in the vessel may be on the spot. The quay superintendent thereupon makes a transference of positions of the two cargoes if they are of similar quantities. In the event of its not being possible to do this through the quantity being different, or through there being no other consignment available at the time to substitute, the loading of the vessel is held up or that particular lot is left out. An important factor in expeditious loading depends to a great extent upon works sending on their consignments in time.

With the quay superintendent installed, the sources of delay, which were previously of frequent occurrence, are being largely eliminated, much to the satisfaction of shippers and shipowners, for thereby the risks of demurrage and excessive freights are materially lessened. The full effect of the organisation will not be possible until the superintendent is provided with adequate office accommodation and staff at the jetties and is linked up by telephone with every department. At present he is accommodated in the shunters' quarters, which leaves much to be desired for the successful carrying out of his intricate and responsible duties. The G.W.R. having appointed the superintendent, who has proved his capacity for the job under exacting circumstances, should now complete the good work by providing him with up-to-date office accommodation and equipment without delay, so that the full benefit of the new arrangements may be obtained.

Mr. Glasson states that the new No. 8 electrical jetty is doing its work splendidly. In an 8-hour day recently, 96 trucks of China Clay, representing about 1,000 tons, were loaded into vessels there. Shipping has been severely handicapped in December and early this month through the violent gales. Since the December lull in trade, there has been a revival in shipping, especially for America, three steamers recently taking from 7,000 to 8,000 tons each.

Pipe-Lines for Liquid China Clay

By "China Clay Captain"

FOR conveying liquid China Clay while in solution with water from the pumps to the pits, and again from the pits to the tanks, often miles away, the channel most frequently used nowadays is made of earthenware pipes. Also for conducting back the washing water in the "repeating systems" pipes as a rule are used, especially where the track crosses cultivated fields or gardens. On the moors and commons sometimes open leats are used, and at some of the older works stone conduits may still survive.

Before the introduction of pipes, conduits seem to have been almost the only channel, as clay workers are constantly coming across them while going over "old men's workings." For instance, at the reopened clay works near Goonamares, St. Stephen's, there is a very good example of these primitive channels. It was a good stroke of business for the pipe-makers when they first introduced their ware into the China Clay district, for at the present time doubtless there are hundreds of miles of pipe-lines laid in and around the clay mines. Being underground, out of sight, they do not appear to the ordinary observer, who, seeing wood launders, steel pipes, iron pumps, or concrete channels fixed on trestles or supports to maintain the necessary elevation where the ground is not favourable for pipes, may possibly think that these channels are the only medium through which the clay in suspension is moved about. But those who live in the district, who see the great stacks of pipes at the stores department being constantly depleted and added to by the truck load, know that pipes form a very large item in the bill of costs of a clay mine.

Size of Pipe

The size of pipe most frequently used is of 9 in. internal diameter. I know of no statistics to quote from, but from personal observation should say that 90 per cent. of the pipes used are of that size. This may at first sight seem peculiar, when one thinks of the different washing streams, ranging from 150 to 1,200 gallons per firm. Probably it comes about in this way. The small works, when laying down their pipe-lines, allow for expansion. The larger works, if one pipe is not enough, lay two side by side—anything less than 9 in. being more liable to choke; anything larger not so portable or easy to handle. Having started along these lines, the merchants only stock large quantities of what is in popular demand, which is also a factor in deciding when a works manager wants a line laid down in a hurry.

Sealing

The manner of making the joints is of vital importance. The pipes being made in 2 ft. or 2½ ft. lengths, there are from 40 to 50 joints in every 100 ft. of pipe-line, and if not made staunch not only will there be a waste of clay, leaking *out*, but during heavy rains impurities may percolate *in*, and damage the clay, or if near trees the roots will find their way in through very tiny apertures, restrict the flow, and in time practically choke the pipe.

I remember once, while digging up an old pipe-line, finding that the root of a hawthorn had entered a bad joint and flourished so amazingly that the matted fibres were quite 18 ft. in length and as thick as a man's thigh. If pipes are only laid temporarily at the edge of the pit, to come out again as the work extends, joints made with old clay bags or even "marshy turves" would serve, but for permanent lines cement and sifted sand in the proportion of three to one is best. If carefully done, and each joint "wiped out," the cement being allowed sufficient time to set before the trench is filled in, the trench itself being deep enough to allow for severe frosts, this gives an ideal channel for clay.

Abnormal places should receive special attention. Under roads and railways iron or steel pipes should be used, or on a new embankment or addle ground.

If the pipe-line gradient varies—sometimes steep, sometimes nearly level—air-shaft or expansion chimneys are of service to regulate the flow and to prevent air-locks, while a grating at the beginning and turn-out sluice valves at the lowest points are of use in very long lines.

Further, a scale map showing everything from A to Z is of real service. In the long run it will save much labour, for man's memory is short.

Dissolution of the Association

Producers' Views on the Situation

MR. W. ROSE, senior partner in the firm of North and Rose, China Clay producers, St. Austell, has made an interesting statement forecasting the future of the China Clay trade in the light of experiences following the break-up of the China Clay Producers' Association.

"The outgoing year," he says, "has been one of surprises and disappointments to the producers in the industry. It began with well-founded expectations that the world demand for English clays was increasing, and that, with stabilised prices showing an average moderate profit, the larger output, with its smaller percentage of overhead expenses, would allow of a margin for developments and extensions and increased employment. The regretted break up of the 'Associated' and the immediate tremendous reduction in prices of medium and common clays entirely prevented these hopes being realised, and the loyal—as well as the few disloyal—members have been and are recognising that even an imperfect organisation is better than none. The lesson was meant to be severe in its application, and therefore permanent in its results, and it is likely that when the time comes, as it must, for a new association, the whole of the trade will take up the membership with a clearer idea of its responsibilities and privileges.

Loss Borne by Producers

"A phase of the present trouble is that the whole of the loss is being borne by the producers, who have put their energies and capital into the business. Of course, no one is responsible for the position but the few members who broke away, but it is a fact that so far landowners have benefited by the larger royalties on the increased shipments at the lower prices, while employment has hardly been interfered with. In the meantime users of China Clay of the above two qualities are greatly increasing their profits at the expense of the district. The present position cannot possibly go on indefinitely, and the question is how soon it will be done away with.

New Association Needed

"To this question a fairly cheerful reply may be given. Immediately on the break up of the 'Associated' those members who produced best clays, recognising that for these qualities there was no need of any particular reduction in prices, held a meeting and formed themselves into a new Association, working very much on the lines of the previous one. It is now proposed that a similar organisation shall be formed to deal with the medium clays, and a preliminary meeting will shortly be called by some of the leading firms. In all probability the outcome will be the formation of a new association representing practically every producer and every quality.

"After all, the numbers are small and the industry concentrated in the two sister counties, and even more important is the knowledge that men have obtained of each other in co-operation for mutual ends. While mistakes have been made and opportunities for the development of the industry have been neglected, there has been constant appreciation of the good faith of the leaders and their unselfish care that fair play should be the right of all members, small as well as large.

Competitors' Good Feeling

"Perhaps the most encouraging item in the competition is the personal good feeling existing among those who have to take a part in it. So far there has been no trace of bitterness or enmity. All the evidence seems to point to one central organisation being shortly set up, perhaps with greater powers, and with these an enlarged vision of its possibilities for good. In the meantime it is satisfactory to know that prices for 1925 show that producers will not continue to work without a living profit for themselves, as well as royalties for landowners and wages for their workmen. The whole industry can and will be prosperous again. The world's demand is bound to be much larger in the future as new uses are discovered and present ones developed."

New Coating Paper Mills

Scottish Developments May Help China Clay Industry

GREAT developments in the coated paper-making industry in Scotland have been recently disclosed in the annual report of the Inveresk Paper Co., Ltd., which should be good news for China Clay producers. The announcement is particularly welcome to us because we have frequently referred in *The China Clay Trade Review* to the comparative slowness with which paper-makers in this country have followed the lead of the China Clay coated paper manufacturers of the United States and Canada. At the annual meeting of the company, held in the third week in November at Edinburgh, the chairman, Mr. William Harrison, in presenting the report and balance sheet, and declaring a dividend of 12½ per cent., said: I should like to refer to our acquisition of a controlling interest in the Carrongrove Paper Co., Ltd. In February last an opportunity arose of acquiring this control by the purchase of 111,000 ordinary shares of £1 each in the Carrongrove Company, and your directors, in the interests of the company, lost no time in completing the purchase. Several of your directors have joined the board of the Carrongrove Company. The Carrongrove report and balance sheet for the year ended October 31 last shows a gross profit of £90,776 on the year's working, plus £5,864 brought forward, leaving an available balance of £54,657. A dividend of 5 per cent. has just been declared on the Carrongrove Company's ordinary shares, £5,000 is carried to reserve, and £29,507 is carried forward.

The financial position of the Carrongrove Company is a strong one, and your directors look forward with every confidence to the future prosperity, not only of your own mills at Inveresk, but also at the Carrongrove Mills, which, thanks to the vision of their able managing director, Mr. William M. Wallace, are probably the finest and most modern esparto mills in Great Britain.

Success With Fine Coated Papers

The Inveresk Mills have been established over half a century, and have for many years past held a high reputation for producing one of the best esparto papers, and certainly the finest coated papers in the market. The prosperity of your company is due in the first place to its exceptional location for coal and shipping, and, in the next place, to the high quality of its productions, which are known to every buyer and user of high-class esparto and coated papers. We have in Mr. Snelling an able and energetic managing director, and his efforts are concentrated in maintaining the high quality of our productions. At the Carrongrove Mills we are just completing the erection of one of the largest and most modern of coating factories, and it will be the aim of the Carrongrove Company, in which we are now so greatly interested, to produce, by close co-operation with the best skilled men we possess at Inveresk, from the starting up of the new factory, a first-class coated paper.

Although we are fully employed at the Inveresk and Carrongrove Mills, I am sorry to say, speaking generally, there has been no improvement in the paper trade of this country during the year under review. We are making at our mills esparto and coated papers of the highest quality, and although all paper manufacturers in this country suffer in a greater or less degree by the importation of this foreign paper, we suffer at our mills less than mills which are making lower grades of paper. Great Britain is a very large consumer of paper, and in the first ten months of this year we imported approximately £12,000,000 worth of foreign manufactured paper, whereas the paper mills of this country exported abroad in the same period only £7,628,000 of British manufactured paper, of which well over 80 per cent. went to our colonies, especially Australia and New Zealand.

The New Coated Paper Factory

Presiding at the annual general meeting of the Carrongrove Paper Co., Ltd., at the Hotel Russell, London, on November 21, Mr. Harrison made further reference to the acquisition of the controlling interest in the Carrongrove Company. He said: This fact we confidently believe will carry with it considerable benefits to your undertaking, and especially so in regard to the new coating factory. We hope our new extensions will be in full running order in the new year.

China Clay Notes and News

Export Trade and U.S.A.

The export trade in China Clay for November was 48,099 tons, value £106,872. These figures include china stone, but not ball clay. The balance between the export and home trade was 27,359 tons. The drop in the total monthly figures was largely due to a falling off in the export tonnage.

The chief importing countries in November were: United States of America, 20,936 tons, value £42,284; Belgium, 4,578 tons, value £8,160; Germany, 4,299 tons, value £10,907; Netherlands, 4,202 tons, value £9,291; Italy, 3,970 tons, value £8,962; Sweden, 2,465 tons, value £3,813; Finland, 1,683 tons, value £3,797; India, 2,351 tons, value £9,332. A feature of the exports was the increased tonnage to Germany, which for the first time since the war has risen to third place in the list.

The market in which the competition is the keenest, because it is the most valuable to the home China Clay industry, is that of the United States, where the domestic clay industry is being assisted in many ways by the Mineral and Geological Departments of that Government. The effect of this competition has been felt most in our common clays, which, to a large extent, have been displaced by the American domestic article, of which American industries are using increasing quantities. Our best clays still hold their own in the American market. The home industry is feeling the need of a bigger outlet for its common grades, which it is hoped will result from the low prices now prevailing.

The Year's Trade

Despite the falling off in tonnage in the latter part of the year (the drop in November below the previous month was 10,000 tons), the total trade for the year was maintained at a level well ahead of 1923, a fact that would be very satisfactory if the average prices for the year had been equal to those of the previous year. Through the severe cut in prices during the latter part of the year the monetary benefit accruing to the industry by the increased volume will be very little more than, if as much as, resulted from the much lower tonnage in 1923. The only consolation is that the sacrifices that have been made may lead to such an increased demand this year as will compensate for the negligible margin of profit on which producers have been recently working. With the economies necessary to keep production costs at the lowest possible level, China Clay firms are being more and more driven to the adoption of mechanical equipment and working.

Comparative Statistics

Figures showing the total volume of trade done for the eleven months ended November, compared with the corresponding months last year, are:—

	1924.		1923.
China Clay	743,389	..	685,266
China Stone	47,514	..	36,539
Ball Clay:	32,513	..	18,899
Totals	823,416	..	740,704

The increase in all classes in favour of this year is 82,712 tons, individual increases by China Clay 58,123 tons, china stone 10,975 tons, ball clay 13,614 tons. The big increase in the Devon ball clay section comparatively, which was continuing to grow until the Association broke up, was due to ball clays undercutting the China Clay trade in the potteries, but with the removal of the official fixing of prices the competition is now on an equal footing.

Cornwall's Unemployed

"It is very regrettable there should be an increase of 203 men," said Sir Arthur Carkeek, chairman, at the Midland West Cornwall Unemployment Committee, at Redruth, last month, when Mr. F. C. Bond, secretary, reported the number of persons registered for employment in the area was 3,018 men, 361 women, 48 boys and 37 girls, an increase of 203 men, 1 boy and 33 women, and a decrease of 7 girls compared with the previous month.

Numbers registered for employment at the branch offices were: Redruth, 652; Camborne, 668; St. Austell, 332; Penzance, 400; St. Just, 60; Hayle, 339; Falmouth, 460; Truro, 118; Perranporth, 54; Newquay, 69; Fowey, 151; Helston, 107; St. Columb, 54.

The figures relating to each place named refer to the area and not the town. For instance, St. Austell takes in all of the Mid-Cornwall China Clay district.

Enlargement of China Clay Industry Boundaries

Under the urban extension scheme agreed to by the Urban and Rural Councils of St. Austell, and approved by the Cornwall County Council, St. Austell, the centre of the China Clay industry, is to be enlarged as from April 1, if the scheme is not upset on appeal by the Parish Council, who are threatening to oppose it. If the scheme comes into operation, the port of Charlestown will then be part of the urban area of St. Austell.

St. Austell town will be increased from 196 acres to 1,339, and the population from 3,365 to nearly 6,500. For election purposes the area will be divided into three wards with five representatives for each ward—fifteen members comprising the Council. The western ward will take in the western and central portions of St. Austell west of the line Pentewan Road, South Street, Cross Lane, Tregonissey Road to level crossing, thence across to Menacuddle Hill to Menacuddle Farm, giving a population of 2,852, and 1,326 electors. The central ward comprises the area lying to the east of the same line, taking in Carveth, Watering, Polkyth, Tregonissey and Slades (council houses), bounded by the line Watering Lane, Polkyth Road, Slades, and Carclaze Road to beyond the U. M. Chapel, giving a population of 2,741, and 1,220 electors. The eastern ward comprises Mount Charles, Charlestown, including the east side of Slades Road. On the sea coast the boundary ends at Apple-tree Beach on the east, and Polmear Island on the west, adjacent to Charlestown Harbour.

As regards rate, the official figures as presented at the County Council inquiry showed that the urban rates over a period of eleven years up to 1924 had been lower than those in the areas to be added, namely, Mount Charles, Tregonissey, and Slades, £3 11s. 1½d.; Charlestown, £3 12s. 5d.; Truro Road end of St. Austell, £3 14s. 5d.; St. Austell, urban, £3 8s. 8d. The rates for the current half-year in the Mount Charles district are 8s. 7½d. in the £, and in the Urban 6s. 3d.

Fowey Harbour Master Optimistic

Since the completion of the improvement by the G.W.R. of the equipment at Fowey jetties, and the carrying out of a forward policy by the Harbour Commissioners at the port, as much as 100,000 tons can be expeditiously dealt with every month. The number of vessels taking cargoes varies according to size, and take between 60,000 and 70,000 tons per month during busy spells. Last month 100 vessels were dealt with.

Fowey Harbour Master, Capt. F. Collins, in discussing the matter, says: "We have a very go-ahead board now, and the improvements which have been made in the channel have made it easier for ships to come here, and enabled us to deal with a greater volume of traffic, but we hope to do better still. At present the Harbour Commissioners' dredger is at Plymouth, where it has been used in connection with improvements at the Cattewater. Later, however, the dredger will be used for deepening the channel still more. We aim at getting a depth of 36 feet at high-water springs, and 21 feet at low-water, with 23 to 24 feet at low-water neaps. At present the depth of water at low water spring tides is 18 feet, so that it would mean taking three or four feet off the bed of the river. Our dredger has already removed 600,000 tons of river bed, and the new improvements would necessitate the digging up of a further million tons. We could then accommodate vessels of 15,000 tons very comfortably."

The dredger is a rapid worker, capable of digging 400 tons an hour and touching 58 feet below the water.

No Cause for Lament

A member of the firm of John Lovering and Co., China Clay merchants, St. Austell, declares that the China Clay trade has now reached seven-ninths of the pre-war standard. His view was that there was nothing to lament in the present state of the trade. Business could not, he said, be expected to reach pre-war strength so soon, and it was rather surprising that it had made the recovery it had.

Testimonial to St. Austell Official

In view of his pending retirement from public life, Mr. H. S. Hancock is to receive a testimonial in recognition of his services to education for a period of 50 years and as chairman of the Governors of the St. Austell County School since its establishment. Mr. Hancock has been long associated with the China Clay trade and was one of the directors of the now defunct China Clay Association. Amongst several positions he holds is that of estate agent to Viscount Clifden. The testimonial to Mr. Hancock is to take the form of a scholarship at the County School for any boy or girl resident within the area of the St. Austell District Education Committee. Mr. James Perry, co-governor of the County School and a prominent China Clay merchant, is hon. treasurer of the Fund.

China Clay Firm's Transfer

During the past month the transfer has been effected of the Halviggan China Clay Works, owned by Tehidy Minerals, Ltd., to Cornish Kaolin, Ltd., the owners of the Glynn Valley China Clay Works. A description of both these works was given in the October issue of the CHINA CLAY TRADE REVIEW. Both companies have been closely associated through the directorate of both concerns, though they were worked separately. In future they will be carried on by, and be under the control of, Cornish Kaolin, Ltd., the whole of whose output is controlled by Varcoes China Clays, Ltd., of which Mr. C. Stewart Varcoe is the managing director, and on the board of which Tehidy Minerals and Cornish Kaolin have been represented.

Mr. R. M. Richards, the works superintendent of Cornish Kaolin, Ltd., is shortly proceeding to Malay on behalf of his firm, to make an inspection of Malayan China Clay works and deposits.

Developments at North Goonbarrow China Clay Work

New developments are proceeding at the old-established works of the North Goonbarrow China Clay Co., Ltd., a feature being the introduction of new machinery for the generation of electricity for power purposes. An innovation is the introduction of a new type of high-compression crude oil engine of 132 B.H.P., to drive electrical plant which is first to be used for providing power for the pumps and later will be extended to other branches of work such as winding. We hope in a later issue to give a description of the North Goonbarrow China Clay Works, of which the managing director is Mr. Hart Nicholls.

Mineral Geology of Cornwall

There is a great deal of useful information in the paper on "Geology" by Mr. S. H. Davison, B.Sc., F.G.S. (Head of the Department of Geology and Mineralogy, Camborne School of Mines), which is printed in the brochure "Cornwall" in connection with the International Mining Exhibition in London last year. "The County of Cornwall," he says, "is unique among English counties as regards the geological features it displays. Built up as it is of ancient sedimentary rocks which have been intruded by acid igneous rocks, the phenomena of contact metamorphism and mineralisation are to be seen in great variety." Then he makes a survey of the geological history of the county, shows how the mineral contents of the Cornish lodes vary with increasing depth, and furnishes particulars of the likely positions for the finding of various minerals, including iron, manganese, antimony, lead, zinc, silver, uranium, copper, arsenic, tin, and wolfram. China Clay, china stone, and other mineral products are alluded to, and there is the summing-up that "Cornwall can, therefore, claim to be exceptionally prolific in mineral products, and discoveries of new economic products are constantly being made." A paragraph in Volume II. of the "Transactions of the Cornish Institute of Engineers" says: "It has long been recognised that much valuable work remains to be done in the way of systematic geological investigation in the mining districts of Cornwall. Attention has recently been drawn to the subject in the discussions following the papers read by Messrs. J. Jennings, T. C. F. Hall, and J. S. Whitworth at meetings of the Cornish Institute of Engineers.

Cornwall Geological Society's Researches

The Royal Geological Society of Cornwall annual meeting was held at Penzance last month, when papers were read and Mr. John B. Cornish was presented with the Bolitho Gold Medal for his long services to the Society, of which he has been hon. secretary for about 28 years. The Council reported that they had arranged with the Camborne School of Mines for classes in elementary geology by Mr. Davison, and members were invited to attend. The Council had consented to provide space for a loan collection of minerals from Mr. Boyne, St. Just.

A paper on "Pneumatolysis" was read by Dr. R. H. Rastall (Christ College, Cambridge). It dealt with the processes associated with ore formations and their connection with the origin of volcanic rocks, illustrated by references to the conditions prevailing in Cornwall and other regions. There was also reference to the formation of China Clay and the sources of the large crystals of mica (which had considerable commercial value in India and East Africa) as well as the general conditions of formation of valuable minerals. The laws governing these processes, it was said, were mainly of a chemical and physical nature, with little obvious connection with mining. Nevertheless, it was pointed out, the detailed study of, and the deductions drawn therefrom, were of real practical value in association with the development of the mineral resources of the Empire.

In acknowledging the presentation to him of the Bolitho Gold Medal, Mr. J. B. Cornish said he did not think the apathy in regard to geological matters by the public was due to such things as league football. It was a simple new science 100 years ago, followed for the love of it as such. To-day the geologist was a professional man, with such prospects as to make it worth while for him to study his profession. The only requirement for the beginner in geology was a "pair of eyes."

It was stated that the members had considerably increased during the year, and there were signs that a more useful period for the Society was ahead. The following officers were elected: President, Mr. F. J. Stephens, Camborne; Vice-Presidents, Lord St. Levan, Dr. Richard Pearce, Messrs. J. B. Cornish and Solomon James; Council, Messrs. W. Colenso, F. Holman, J. M. Coon (St. Austell China Clay geologist), M. T. Taylor (East Pool Mine), and F. C. Cann (Geevor Mine); hon. secretaries and curators: Messrs. J. B. Cornish and E. H. Davison (Camborne School of Mines).

4,720,000 Tons of Newsprint

According to a recent estimate, the world's annual production of newsprint paper amounts to approximately 4,720,000 tons. At the present time the United States takes first place among the newsprint producing countries of the world, being closely followed by Canada, which, in all probability, will assume the leading position in 1925. Next in order are Great Britain, Germany, Sweden, Finland, and Japan, with France and Norway not far behind. Other countries of Europe produce smaller quantities, mainly for domestic requirements, and Newfoundland manufactures some 65,000 tons annually, practically all of which is shipped to Great Britain. The United States is by far the largest importer of newsprint, and Canada holds the leading position as an exporter of that commodity.

Canada's production of 1,263,000 tons is the actual total for 1923. Since the beginning of this year, however, the capacity of Canadian mills has been increased by 500 tons daily, and, with new machines now under construction, the capacity in 1925 will be over 1,500,000 tons. The largest newsprint producer is the United States with 1,485,000 tons in 1923. The mills in that country, however, supply little over 50 per cent. of the newsprint consumed, and in 1923 no less than 1,309,000 tons were imported to augment the domestic supply and satisfy the tremendous demand. Of the Canadian production, about 90 per cent. is exported, and the United States provides the principal market.

In view of these facts, it is natural that English China Clay producers are keen on meeting the requirements of papermakers in the United States and Canada, where the growing competition of inferior and less suitable domestic clays has to be met.

Canada's Growing Paper Production

The preliminary report of the Canadian pulp and paper industry for 1923, recently issued by the Forest Products Branch of the Dominion Bureau of Statistics, indicates that this most important activity has made another advance in the process of recovery from the unsatisfactory conditions

three years ago. From the time of its establishment in Canada in 1803 until the post-war depression of 1921, paper-making showed a steady increase. There was a heavy falling-off in 1921; 1922 was a period of readjustment, but with increases in several lines, and 1923 shows a total increase. If the net value of production for the entire pulp and paper industry be considered as the sum of the value of (1) pulpwood exported, (2) pulp made for export, and (3) paper manufactured, then the totals for the years mentioned stand as follows: 1920, $230,199,717; 1921, $157,426,587; 1922, $152,209,711; 1923, $183,266,218. The capital investment of $417,611,678 represented an increase of 9·6 per cent. over 1922. The total number of employees was 29,179, as compared with 25,830 in 1922, and the total pay-roll $38,305,157, as compared with $32,918,955. The province of Quebec maintained the lead on the production of wood pulp, the value of which was no less than $50,255,367. This province also led in the production of paper, valued at $58,566,143.

West Cornwall China Clay Development

Whilst the output of China Clay in West Cornwall is small compared with that of mid-Cornwall, it is a matter of interest to learn that there is every likelihood of an extension of the industry of China Clay in that part of the county. Capt. Denis Shipwright, son-in-law of the late Sir Edward Hain, the shipowner, and formerly M.P. for the Penryn-Falmouth Division, who is developing the Porthia China Clay Works, has announced the discovery of three new deposits of China Clay, which means that there is a rosy prospect of the activities of this company for extension. Such was the opposition to his proposal to ship clay from St. Ives Harbour that he withdrew his application to do so, to the benefit of Hayle and Penzance. Now Capt. Shipwright has secured storage accommodation at the Penzance Harbour, so that the prospective increased business will mutually benefit the company and the town of Penzance.

Crockery and Porcelain to British Malaya

There is a universal demand for crockery articles by the inhabitants of Malaya, says the Malay States Information Agency. More than a million Chinese live in the country, and teapots, teacups and rice-bowls are a necessity to every Chinaman. Malays, too, numbering well over a million, create a demand for similar household requisites. Brass and woodenware do not in Malaya, as in some Eastern countries, take the place of earthenware and china utensils. This demand is being satisfied to an increasing extent by imports from China and Japan. To compete with these countries it would be necessary for United Kingdom pottery manufacturers to place on the Malayan market articles of crockery of the size and shape to which the native is accustomed at a very low price.

Insulator Imports to Australia

Questions asked by Mr. Fenton regarding the importation of Austrian telegraph and telephone insulators, and the use of locally-made insulators, were answered by the Postmaster-General in the Commonwealth House of Representatives recently. Mr. Gibson said that insulators had been imported from Austria because it was impracticable to obtain in Australia sufficient insulators to meet the needs of the Postal Department's requirements at the time. With regard to the Australian article, 1,594,000 insulators, valued at £57,000, were supplied by the Firebrick Insulator and Pottery Co., a branch of whose works was situated at Maribyrnong, and they had given satisfaction. It was the practice of the Department to obtain all supplies of insulators from Australian manufacturers as far as they were able to meet the demand. We wonder if the Australian manufacturers are aware that China Clay has been proved to be one of the best insulating materials by the electrical trade in this country.

Kaolin from Nova Scotia

Dr. E. D. Faribault, of the Geological Survey Branch of the Dominion Department of Mines, has just investigated the discovery of a deposit of kaolin lying near Victoria Beach, in the North Mountain, Nova Scotia. It is similar to material found in the South Mountain, and is understood to contain 40 per cent. of kaolin. While not adapted for the manufacture of fine clay, there are many uses to which the material can be put, and it is considered not improbable that both deposits will be developed at an early date, as proximity to the Port Wade pier will make shipping facilities easy.

Australian Pottery Clays

A bulletin issued by the Institute of Science and Industry, covering investigations into the value of Australian clays and earths for the manufacture of pottery, says that the value of pottery imported into Australia is about £700,000 a year. The investigation showed that the quantity of suitable pottery clays available in Australia is very great, and that there is reasonable assurance that the quality of the deposits is good. Tests showed that the Australian clays were capable of being manufactured into pottery and porcelain of the finest quality, and it is stated that the Australian ceramic industry would be greatly assisted by the establishment of definite industries handling raw materials, such as china, and ball clays, felspar and quartz. It is contended that if the output and turnover of the industry were reasonable in quantity an efficient plant for the manufacture of china-ware should be able to produce goods able to compete successfully with imported wares.

Cornwall Road Costs and Effect on China Clay Industry

On the subject of highways expenditure, the Finance Committee reported to the Cornwall County Council last month that the gross sum for 1925-6 would probably be £300,000, including £168,000 for ordinary maintenance and surfacing, as in 1924-5, and £100,000 for extension of the special surfacing scheme. Excluding any expenditure on unemployment and relief works, it was estimated that £283,500 would be spent, towards which there would be grants of £110,000 from the Ministry of Transport, the balance of £173,500 being provided out of the rates, which would necessitate an increased rate of about 1s. in the £ for highway purposes during the next financial year. The Committee recommended the provisional approval of the approximate estimate.

Mr. T. R. Grylls said the report was a natural corollary of what they were told by the Committee last April. If half a million was wanted then and they had only £100,000, it was natural they must provide the remainder. The Main Roads Committee were probably going to ask for the provision of an additional £100,000 out of their rates. They had reached the extent of their borrowing powers, and he was not sorry. If they borrowed, £50,000, which they might get for seven years, they would have to pay back £60,000. They could not maintain their roads with the present traffic on the same basis as previously and they had to face that.

As the China Clay areas of Cornwall pay a large proportion of the rates entailed by the upkeep of the roads, these figures relating to future expenditure are disquieting.

Where China Clay Comes in in Paper-making

When paper is made from wood, the wood is first ground up and chipped; when it is made from other materials the first step is always to comminute the stock. Then the particles are treated with chemicals in digesters. After the impurities have been rendered soluble and removed, the digested stock is fed into beaters, which pulp the stock by subjecting it to a combined compression and shearing action between steel blades, fastened on a roller and embedded in a bed-plate in the bottom of the beater. The water in which the stock is beaten is caused to combine with the fibre, which becomes hydrated.

During the course of beating, various substances, which are employed in changing the properties of the fibre so that various kinds of paper can be made from one and the same stock, are added. This is where the China Clay first enters into the process of paper-making. Thus, in making paper used for writing and printing and required to hold ink, resin solution and sulphate of alumina are added. Colouring matters of various kinds, fillers, such as China Clay, are also added. In making white paper, the pulp is bleached with ordinary bleaching powder or liquid chlorine in a special beater. Then the pulp is ready to be made into paper, which is carried out on a cylinder or shaking wire—Foudrinier—machine. The paper is dried and calendered to give it different finishes; here China Clay again plays its part in imparting the glaze to "art" and "imitation art" papers. For calendering purposes the China Clay has to be of the finest quality and free from grit.

Shipping and Export News of the Month

We give below the latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—December, 1924

Date of Arrival.	Name.	Sailed.	Destination.
Dec. 1,	s.s. *Westdale*	Dec. 5,	Fleetwood
Dec. 2,	s.s. *Snofrid*	Dec. 6,	Sarpsborg
Dec. 2,	s.s. *Dinorwick*	Dec. 8,	Fleetwood
Dec. 2,	s.s. *Shellie*	Dec. 5,	Fleetwood
Dec. 2,	s.s. *Schwan*	Dec. 9,	Harburg
Dec. 2,	s.s. *Industria*	Dec. 5,	Bilbao
Dec. 2,	s.s. *Spaarnestroom*	Dec. 6,	Amsterdam
Dec. 2,	s.s. *Halton*	Dec. 6,	Liverpool
Dec. 2,	s.s. *Neptune*	Dec. 8,	Mevagissey
Dec. 2,	s.s. *Shoreham*	Dec. 9,	Runcorn
Dec. 3,	s.s. *Bruxelles Maritime*	Dec. 10,	Brussels
Dec. 3,	s.s. *Abington*	Dec. 3,	Preston
Dec. 3,	s.s. *Queenie*	Dec. 9,	Runcorn
Dec. 3,	m.v. *Vledderveen*	Dec. 14,	Harburg
Dec. 3,	s.v. *Hansea*	Dec. 16,	Hamburg
Dec. 3,	s.v. *Francis and Jane*	*	
Dec. 4,	s.s. *Julia*	Dec. 5,	Par
Dec. 5,	s.v. *Olive Branch*	Dec. 19,	Weston Point
Dec. 5,	s.s. *Camberway*	Dec. 10,	Rouen
Dec. 5,	s.v. *Ada*	*	Weston Point
Dec. 6,	s.v. *Emily Warbrick*	Dec. 17,	Runcorn
Dec. 6,	s.s. *Cornish Trader*	Dec. 10,	Antwerp
Dec. 6,	s.s. *Kassala*	Dec. 14,	Philadelphia
Dec. 7,	s.s. *Calluna*	Dec. 11,	Brussels
Dec. 8,	s.s. *Scartho*	Dec. 12,	Antwerp
Dec. 8,	s.s. *Falmouth Castle*	Dec. 11,	Runcorn
Dec. 8,	s.s. *Allenwater*	Dec. 13,	Liverpool
Dec. 8,	s.s. *System*	Dec. 13,	Gravesend
Dec. 9,	s.s. *Farfield*	Dec. 13,	Preston
Dec. 9,	s.s. *Orleigh*	Dec. 13,	Ridham
Dec. 9,	s.s. *Smaragd*	Dec. 13,	Rouen
Dec. 10,	s.s. *Florentino*	Dec. 16,	Genoa
Dec. 10,	s.s. *Glen Mary*	Dec. 13,	Runcorn
Dec. 10,	s.s. *Ferndene*	Dec. 19,	Antwerp
Dec. 12,	s.s. *Port Said Maru*	Dec. 23,	Portland, Me., and Boston, Mass.
Dec. 12,	s.s. *Ualan*	Dec. 18,	Rouen
Dec. 13,	s.s. *Herfinn*	Dec. 19,	Skien
Dec. 13,	m.v *Hope*	*	
Dec. 14,	s.s. *Urpeth*	Dec. 19,	Brussels
Dec. 14,	s.s. *Clara Monks*	Dec. 20,	Preston
Dec. 14,	s.v. *Hilda*	*	
Dec. 14,	s.v. *My Lady*	*	
Dec. 15,	s.s. *Port Augusta*	Dec. 31,	Philadelphia
Dec. 16,	m.v. *Grietze*	Dec. 18,	Harburg
Dec. 16,	s.s. *Spaarnestroom*	Dec. 23,	Amsterdam
Dec. 16,	s.s. *Cairndhu*	*	Portland, Me.
Dec. 17,	s.s. *Christiana*	Dec. 20,	Birkenhead
Dec. 17,	s.s. *Chloris*	Dec. 23,	Harburg
Dec. 18,	s.v. *Maolin*	*	
Dec. 19,	s.s. *Slievenamon*	Dec. 25,	Weston Point
Dec. 19,	s.s. *Turkestan*	*	Baltimore
Dec. 19,	s.v. *Alert*	*	Runcorn
Dec. 19,	s.s. *Morena*	Dec. 20,	Charlestown
Dec. 19,	s.s. *Cambalu*	Dec. 24,	Liverpool
Dec. 19,	s.s. *Lakewood*	Dec. 24,	Ghent
Dec. 20,	s.s. *Balfron*	Dec. 25,	Garston
Dec. 20,	m.v. *Margot*	*	Drammen
Dec. 21,	s.s. *Alice*	*	Preston
Dec. 21,	s.s. *Edern*	Dec. 24,	Charlestown
Dec. 22,	s.s. *Falmouth Castle*	Dec. 30,	Runcorn
Dec. 24,	s.s. *Glencona*	Dec. 28,	Liverpool
Dec. 25,	s.s. *Robrix*	Dec. 26,	Par
Dec. 26,	s.s. *Bauta*	*	Philadelphia
Dec. 28,	m.v. *Vestland*	*	
Dec. 28,	s.v. *Ideros*	*	Par
Dec. 29,	s.s. *Isabelletta*	*	Runcorn
Dec. 29,	s.v. *Ideros*	*	Par
Dec. 30,	s.s. *Overton*	*	Liverpool
Dec. 31,	s.s. *Sutton*	*	Aberdeen
Dec. 31,	s.v. *Helena Anna*	*	Weston Point

* Signifies " in Port."

Charlestown Shipping—December, 1924

Arrivals

Date.	Vessel.	From
December 2	*Abington*	Portreath
December 2	*Snow Queen*	Penrhyn
December 3	*Heatherlea*	Shoreham
December 5	*Magrix*	Truro
December 7	*Albatros*	Cardiff
December 10	*Concordia*	Lovisca
December 11	*Vera*	Trangsund
December 11	*Veloorae Maritime*	Firth
December 11	*Overton*	Porth
December 13	*Paquerette*	Nantes
December 13	*Treleigh*	Newport (Mon.)
December 17	*Glencose*	Salcombe
December 17	*Glencona*	Cardiff
December 20	*Marena*	Fowey
December 24	*Edern*	Porth
December 26	*Valan*	Rouen.

Sailings

Date.	Vessel.	Destination.
December 3	*Abington*	Preston
December 3	*Snow Queen*	Runcorn
December 6	*Heatherlea*	Rochester
December 7	*Magrix*	London
December 13	*Overton*	Antwerp
December 14	*Albatros*	Nantes
December 14	*Veloorae Maritime*	Brussels
December 18	*Treleigh*	Runcorn
December 20	*Glencose*	London
December 23	*Glencona*	Liverpool
December 24	*Paquerette*	Nantes
December 24	*Marina*	Western Point
December 31	*Valan*	Ghent
December 31	*Edern*	Larne

Par Harbour Shipping—December, 1924

Arrivals

Date.	Vessel.	From.
December 2,	s.v. *Mary Barrow*	Fowey
December 2,	s.s. *Scartho*	Abo
December 3,	s.s. *Jolly Iris*	Keadby
December 5,	s.s. *Julia*	Avonmouth
December 7,	s.v. *Eclipse*	Port Houstock
December 9,	m.v. *Katie*	Port Houstock
December 10,	s.v. *J. N. R.*	Plymouth
December 10,	s.v. *Triumph*	Plymouth
December 11,	m.v. *Anna*	Exmouth
December 11,	m.v. *Gaelic*	Cork
December 12,	m.v. *Irene*	Salcombe
December 12,	s.s. *Velocity*	Cardiff
December 16,	s.s. *Towy*	Penryn
December 26,	s.s. *Robrix*	Plymouth
December 26,	s.s. *Ebbrix*	Teignmouth
December 29,	s.v. *J. Milton*	Falmouth

Sailings

Date.	Vessel.	From.
December 1,	s.s. *Westdale*	Fowey
December 2,	s.v. *Henrietta*	Weston Point
December 7,	s.s. *Jolly Iris*	Plymouth
December 7,	s.s. *Julia*	Cardiff
December 8,	s.s. *Scartho*	Fowey
December 10,	s.v. *Mary Barrow*	Queenborough
December 12,	s.v. *Englishman*	Queenborough
December 14,	m.v. *Katie*	London
December 16,	s.v. *Eclipse*	Pentewan
December 16,	s.v. *J. N. R.*	Pentewan
December 16,	s.s. *Velocity*	Newlyn
December 17,	m.v. *Anna*	Antwerp
December 17,	m.v. *Irene*	Gloucester
December 18,	s.v. *Triumph*	Plymouth
December 18,	s.s. *Towy*	Penarth
December 20,	m.v. *Gaelic*	Devonport

December Deliveries

1924 marks a Considerable Improvement

As is usually the case, owing to the Christmas holidays, there was a lull in China Clay business in December, the drop in tonnage compared with November having been 6,000 tons in all classes. An additional depressing factor was the boisterous weather experienced in the latter part of the month that seriously affected shipping. The year's total tonnage in all classes shows an increase of more than 90,000 tons over the previous year, China Clay being responsible for over 60,000 tons of the increase, and china stone for 10,000 tons. The China Clay and stone deliveries were within 6,000 tons of the best post-war year of 1920, and within 80,000 tons of the best pre-war year of 1912.

Monthly Figures

	China Clay.	China Stone.	Ball Clay.	Total
	Tons.	Tons.	Tons.	Tons.
Fowey	52,239	2,442	3,083	57,764
Charlestown	4,627	—	—	4,627
Plymouth	2,100	6	—	2,106
Par	1,598	165	—	1,763
Newham	189	—	—	189
By rail	4,107	—	—	4,107
December total	64,860	2,613	3,083	70,556
November total	71,546	3,912	1,238	76,696
October total	80,197	3,693	2,821	86,711
September total	74,157	4,368	3,342	81,868

Twelve Months' Figures

	China Clay.		China Stone.	
	1924.	1923.	1924.	1923.
11 months' figures	743,389	685,266	47,514	36,539
December	64,860	62,404	2,613	3,649
	808,245	747,676	50,127	40,188

	Ball Clay.		Totals.	
	1924.	1923.	1924.	1923.
11 months' figures	32,513	18,899	823,416	740,704
December	3,083	3,077	70,556	62,404
	35,596	21,976	893,972	803,108

China Clay Exports

RETURN showing the exports of China Clay, the produce or manufacture of the United Kingdom, from the United Kingdom to the several countries of destination registered durng the month ended December 31, 1924 :—

COUNTRY OF DESTINATION.	QUANTITY.	VALUE.
	Tons.	£
Sweden	2,172	3,885
Norway	1,826	2,311.
Denmark	582	1,539
Germany	2,948	6,726
Netherlands	2,686	6,353
Java	102	389
Belgium	4,286	7,571
France	3,369	6,034
Switzerland	151	297
Portugal	10	40
Spain	353	1,038
Italy	2,067	5,597
China	5	24
United States of America	23,899	47,735
Mexico	205	817
Peru	15	60
Irish Free State	—	2
Palestine	—	1
Nigeria	—	1
Natal	3,768	11,969
Madras	61	245
Bengal	117	466
Straits Settlements	2	10
Victoria	20	119
New South Wales	6	48
Canada	87	289
Total	48,737	103,566

China Clay Imports for December

A RETURN showing the registered imports of China Clay (including china stone) into Great Britain and Northern Ireland from the several countries of consignment during the month of December, 1924.

Countries whence consigned.	Quantity.	Value.
	Tons.	£
France	10	310
Austria	2	24
Channel Islands	147	294
Total	159	628

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

BURY PAPER MAKING CO., LTD.—Registered December 9, Trust Deed dated December 3, 1924, securing £30,000 debentures; charged on company's leasehold properties in Pilsworth, Heap and Bury, also general charge (except uncalled capital). *Nil. July 18, 1924.

BURY PAPER MAKING CO., LTD.—Registered December 22, £14,900 debentures part of £30,000; charged on company's leasehold properties in Pilsworth, Heap and Bury, also general charge (except uncalled capital); also registered December 30, £5,000 debentures part of £30,000; charged on company's leasehold properties at Pilsworth, Heap and Bury, also general charge (except uncalled capital); also registered December 30, £80,000 (not ex.) 2nd debenture, to J. Preston, The Woodlands, Thornton-le-Fylde, and others; general charge (except uncalled capital and subject to prior debentures). *Nil. July 18, 1924.

New Pottery Companies

UNWINS (LONGTON), LTD.—Reg. No. 201,210. Private company. Registered capital, £7,000 in £1 shares. Objects: To acquire the business of an earthenware manufacturer, carried on by H. R. Perry, at Cornhill Works, Market Lane, Longton, as "Unwins and Co." The directors are Blanche Hawley, J. W. Hamilton, W. A. Howse, H. Halse, H. R. Perry, and A. Deakin. Registered office: Cornhill Works, Market Lane, Longton.

ROPER AND MEREDITH, LTD.—Reg. No. 201,142. Private company. Registered capital, £4,000 in £1 shares. Objects: To acquire the business of an earthenware manufacturer, carried on by L. Meredith, at Garfield Pottery, Longton, Stoke-on-Trent, as "Roper and Meredith." The permanent directors are: L. Meredith (chairman and managing director), A. R. Toplis, and A. N. Hulse. Registered office: Garfield Works, High Street, Longton.

E. BRAIN AND CO., LTD.—Reg. No. 201,537. Private company. Registered capital, £15,000 in £1 shares. Objects: To acquire the lease of the Foley China Works, Fenton, Stoke-on-Trent, together with the business of china manufacturers carried on there by W. H. Brain, as "E. Brain and Co." The first directors are: W. H. Brain, Miss Julia A. Brain, and E. B. Wright. W. H. Brain is permanent governing director and chairman, subject to holding £1,000 shares.

SALT AND NIXON, LTD.—Reg. No. 201,305. Private company. Registered capital, £6,500 in £1 shares. Objects: To acquire by way of lease the china manufactory known as Jubilee Works, Mount Pleasant, Longton, Stoke-on-Trent, and to take over as a going concern the business of a pottery manufacturer, now and for many years past carried on by W. Nixon and his predecessors at Longton, Stoke-on-Trent, as "Salt and Nixon." The permanent directors are: W. Nixon and Mrs. M. L. Nixon.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., 8, Bouverie Street, London, E.C.4. All communications relating to Advertisements, Subscriptions and other business should be sent to the Manager, "The China Clay Trade Review," at the same address. Telegrams—"Allangas, Fleet, London." Telephone—City 9852 (6 lines).

Foreign Competition Menace

THE suggestion that is being made that the time has come for the clay industry as a whole—royalty owners as well as producers—to consider the pooling of interests in order better to counteract the menace of foreign competition, is worthy of attention. Undoubtedly the competition of domestic kaolins in our foreign markets has, through the restriction of transport facilities during the war, become so great as to call for a combined effort on the part of the trade. The China Clay industry is now beginning to feel the effect of the development of China Clay deposits in other parts of the world, and the fact that the test of their value is always a comparison with our clays, shows that ours are looked upon as the acme of quality. We are now seeing the beginning, especially in the American markets, of a systematic, organised, and determined attempt to oust our clays, and it is an experience parallel with that which at first confronted the tin mining industry through the discovery and development of tin in other countries, and which eventually killed the industry in many parts of Cornwall.

What has led to the growth of this foreign competition in the China Clay industry? First, the difficulty of getting supplies over during the war, and, secondly, the increased prices which led foreign countries to turn their attention to the development of their own deposits. While prices have ruled high owing to various justifiable causes, the incentive has been given to those foreign producers to develop, and so long as this state of things continues it will be worth while for them to extend their development still further. The only way in which foreign development can be arrested is for our producers to be able to place their clays in those markets at such a price as to render the foreign produce unprofitable. One way in which this can be done so as to ensure for the industry a fair margin of profit is to cut out wasteful expenditure and to organise the industry as a whole. One method would be by the pooling of interests and the capitalisation of all the separate concerns on an equitable basis of valuation, and the working of the industry by the producers and royalty owners. There is no other raw material producing industry in the country that lends itself so well on account of the fact that it is concentrated in the two Western counties. Whether the various interests are sufficiently alive to the community of interests that exists, and realise where the unarrested foreign clay competition in overseas markets may eventually lead, remains to be seen.

The Lesson of Statistics

IN the ordinary way the statistics showing the volume and incidence of foreign trade in its relation to previous years are not available through the official publications until over a year after the period to which the figures relate, a delay which considerably discounts the propaganda value of the information. We have, therefore, been to some pains, by a careful compilation of the monthly statistics we publish, to produce the total figures relating to each country for the year just closed. These will be found in the following pages, and we venture to suggest that the figures disclose factors which should be extremely useful to China Clay producers and merchants in their campaign to extend the area of their markets both at home and abroad.

The Exports

ONE welcome feature of the figures giving the total trade for the year is the noteworthy increase in the exports, which are nearly 93,000 tons in excess of the previous year. It is usual in arriving at a definite opinion as to the health of the industry to make comparison with the record year of the industry, 1912. In that year the total trade to all markets was 933,933 tons, made up of 661,300 tons export and 272,633 tons home. In the year just closed the total trade has come within 75,000 tons of that total, the export being within 60,000 of the exports for that year. The year 1924 failed by under 6,000 tons to reach the total of the best year, 1920, since the record year of 1912.

In many respects, the figures showing the export trade to individual countries are very encouraging in the face of the increased competition which the China Clay trade now has to contend with from foreign domestic clays. The chief surprise in the 1924 figures is the record volume of business done with the U.S.A., who, despite the great increase in the consumption of their own domestic clays, have created a record by the total of 331,900 tons, being over 45,000 tons in excess of their 1923 total, and 11,000 tons in excess of their previous best year of 1914, when 320,217 tons were shipped. This increase in the United States markets accounts for nearly half of the total excess of exports over the year.

Germany Coming Back

THE second welcome surprise is the steady recovery of the German markets, which show an increase of 13,000 over the previous year, and approach a fourth of their pre-war volume. In 1922, Germany's previous best year since the war, only 11,848 tons were taken. Two factors account for this great improvement: one is the settlement of the Dawes plan, which has stimulated the industries in which China Clay is used, and the other is the new railway tariffs in operation in Germany against adjoining countries. These operate against Czecho-Slovakia, inasmuch as the new railway freights render the Czecho-Slovakian clays less able to compete with our clays, which have suffered by the advantage Czecho-Slovakian clays have had since the war through the operation of the exchanges in their favour.

Lower Average Prices

THE effect of the drop in prices in the latter part of last year is seen in the lowering of the average price by 2s. 6d. per ton, which is greater than appears on the face of it, because it is taken on the whole year's trade, whereas the drop operated for only 3¼ months. With the outlook on the Continent much more favourable than last year, owing to the operation of the Dawes plan and other factors, the prospects for the extension of China Clay markets are such as should result in 1925 coming even nearer the pre-war volume of trade than 1924 has done.

Coated Paper Facts

Utility of China Clay as Coating Material

In view of the growing vogue amongst all paper-makers to use China Clay as a coating material in coated papers, the following information from a French source bearing on the subject will be found interesting to both China Clay producers and paper-makers, especially as the coating paper art has reached a high standard of development in recent years among paper-makers in France.

Coated papers are those to one or both sides of which has been applied a mineral or other coating by means of a suitable adhesive. This definition shows that a complete study of coated papers should cover: (1) The raw materials used—(*a*) adhesives; (*b*) base; (*c*) coating materials. (2) The various operations involved in coating, and the machinery required. (3) The various finishes given to coated papers, and the machinery used. (4) Different types of coated papers. (5) Analysis of coated papers.

The Use of a Binder

The purpose of the "gluing" or binding is to bring together two solid bodies and to make them hold together without using mechanical force, by interposing between them a thin layer of liquid of an entirely different nature, which subsequently becomes solid. In order to get good results the surfaces to be united must be clean to facilitate penetration of the binding material. These surfaces should also be so prepared that the space to be filled by the adhesive is reduced to a minimum, thereby preventing excessive contraction of the adhesive layer and ensuring that the strains will be distributed evenly through this layer. Finally, in order to get good penetration, it is essential that the adhesive be quite fluid, so that adhesives which gel must be heated and applied before they have a chance to cool down.

Factors in Good Coating

The factors required for a proper application of the coating on to the paper are: (1) A good grade of binder, properly used; (2) a smooth, slightly calendered, homogeneous, slightly sized base; (3) a coating which can be used in sheet form, or else intimately mixed with the binder. The binder must ensure perfect adhesion of the coating to the base. It should be relatively cheap to use, and not only must it not interfere with the appearance of the coating, but it should, if possible, improve it. This, in turn, requires that the binder should have a high adhesive power and a fairly low cost price, and that its use should not involve undue complications in equipment or in manipulation. The most widely used binders are undoubtedly gelatin and casein. The general principle of coating paper with these two binders consists essentially in the four following operations: (1) Prepare a solution of the binder; (2) add to this solution the material (usually a mineral pigment) with which the paper is to be coated; (3) spread the resultant mixture over the surface of the paper; (4) dry the coated paper. In view of the fact that the base is hidden by the coating operation, the more essential general characteristics of the coating stock used may be mentioned.

Condition of Base Paper

First of all the surface of the paper must be quite smooth, so as to obtain proper adherence, and have a fine coating; lumps and grit will cause unevenness in the surface of the coating and spoil its appearance. A good surface of the base is obtained by using about 40 per cent. of waste paper stock and giving a machine finish. It is not advisable to calender the base, as it would make it more difficult to obtain good adherence of the coating. In the second place the paper should be uniform, both in texture, especially as regards its thickness, and finish. On holding up the paper to the light the formation should show up even and well-filled. If there is irregularity in the thickness the thinner portions will not be as heavily calendered as the thicker ones, and will consequently be more porous. As a result they will take the coating mixture more regularly, and the coating will also be uneven, Lack of uniformity in finish will have the same effect as irregularity in thickness.

In order to work well on the coating machine, the base should be strong and at the same time flexible. It is also advisable to have bulk, which is obtained by keeping down the proportion of filler to about 10 per cent. The base is preferably three-quarter sized with rosin. This is necessary to ensure proper adhesion of the coating, to prevent the coating mixture from penetrating into the paper or from soaking into it and weakening it. It also retards the deterioration of the coating, for it has a certain protective action on the adhesive. Finally, the paper must not contain any chemicals which could have a harmful effect on any of the constituents of the coating mixture. These requirements hold for practically all grades of coated papers. In special cases there may be other requirements, and various grades of base are required according to the quality of the coated paper. When the coating is coloured, it is a good thing to use a base of approximately the same shade. This has the two-fold advantage that the amount of colour used in the coating mixture can be reduced, and that damage which may subsequently occur to the surface of the coating will be less apparent.

The Choice of Coating Material

There is quite a variety of different coating materials, but there are certain requirements which they all must meet in order to give satisfactory results. In the first place they must have no detrimental effect on the adhesive, so as not to weaken the coating; and as a general rule they should not react with one another. But there are exceptions to this latter rule, especially in the case of coloured coating to obtain proper fixation of the colours. With a given pigment a lower density gives better results, for with a given weight the coating will be thicker and better; and when it is very finely ground proper covering, power, and uniformity can be obtained with a relatively thin coating. Coating materials can be divided into three classes according to the purpose for which they are used: (1) Coating materials proper, which can be sub-divided into materials for ordinary coated papers and materials for special papers; (2) colours; (3) substances added for imparting special properties, either during coating and calendering (increasing the smoothness of the gloss), or for facilitating the working on the coating machine or at the calenders and prevent deterioration of the base or of the coating.

China Clay as a Coater

Amongst the materials used in the ordinary grades of coated paper is kaolin or China Clay. The presence of alumina in China Clay does not interfere with the coating; on the contrary, it improves colouring and gloss. China Clay is a hydrated silicate of alumina, specific gravity 2·2, occurring as grains which can be pulverised to a white, compact, unctuous powder, having a more or less yellowish tinge. It imparts a glossy surface to paper and improves its printing qualities. It should be tested for moisture, grit, and iron. Colour is tested by comparison with a standard sample of blanc fixe, or with a known sample of "paper" clay. The sample to be tested and the standard pigment are each worked into paste with water, and spread side by side on a glass slide. After air drying, the slide is placed on a piece of black or blue paper, and the whiteness of the two is compared. Moisture, which is determined by drying at 100° to 105°, should not exceed 12 per cent. Sand or grit should not exceed 0·1 per cent. There are three methods by which it can be determined: (1) The sieve method, consisting essentially in suspending a weighed quantity of the sample in water, passing through a standard sieve of suitable mesh and collecting, drying, the weighing the resid e; (2) the so-called "levigation" method, in which the lighter portions are removed by a slow current of water which leaves the heavier impurities behind, and (3) the "decantation' method, in which the sample is suspended in a tall narrow vessel, and decanted after allowing sufficient time for the impurities to settle out. Results, in order to be comparable, should always be calculated to a dry basis. The sieve method is the simplest of the three, and is also considered the most accurate. The presence of iron is detrimental to the whiteness of the coating, and it should not be present in amount exceeding 1 per cent. It is determined by fusing the sample with fusion mixture, eliminating silica, reducing the iron with stannous chloride, or zinc; and titrating with permanganate.

Aniline Dyes and Affinity of China Clay

Aniline dyes, for which China Clay has a marked affinity, are used practically exclusively in coated papers, except in a few rare instances. They can be used either as such or in the form of lakes. The latter, however, are expensive, and contain an extremely large proportion of water and of relatively cheap bases on which are precipitated relatively small quantities of dye-stuffs. Moreover, it is very difficult to prepare mixes of uniform concentration, and yet this is highly desirable in order to get good and uniform results on the coating machine. For these reasons, it is preferable to use the powdered dye-stuffs.

Aniline dyes are either soluble in water, soluble in solutions of certain other chemicals, or insoluble. They are held by the true coating pigments, either mechanically, in which case they can be washed out, or chemically, in which case they cannot be washed out. They are held in stable chemical combination by solution of the adhesives most generally used. When a solution of the dye is treated with barium chloride and sulphate of alumina it is precipitated in the form of an insoluble lake. Insoluble dyes can be readily mixed with other coating materials. The method of using the dyes depends on their properties. With soluble dyes, a solution of the colour is first prepared, and is added either to the solution of adhesive to the coating pigment, or to the coating bath. Finally, if necessary, the dye is precipitated by addition of a solution of barium chloride followed by a solution of sulphate of alumina. Insoluble dyes, on the other hand, are suspended in water and are mixed as intimately as possible with the adhesive-pigment mixture. With dyes belonging to different classes, each dye is dissolved separately, and the different solutions are added successively to the coating mixture, beginning with the principal one which determines the general shade of the coating.

Improving the Coating Operation

Spirit of turpentine, amyl alcohol, and milk are used to prevent the formation of, or to "kill," foam. Addition of a few centilitres of spirit of turpentine in the trough of the coating machine is quite enough, and a coating machine does not require more than a litre a day, so that the method is quite economical. Amyl alcohol is allowed to fall drop by drop on the surface of the coating bath. Milk is used in the same way as spirit of turpentine, but a larger quantity must be used. Glycerin and sodium chloride are added to prevent contraction of the coating. They also facilitiate the calendering by preventing fusion of the coating. Substances are also used to render the adhesive of the coating insoluble. The one most generally used is formaldehyde; but as it reacts with dye-stuffs, it must be used with care.

Plymouth Pottery Project

Possibilities of Gas Firing Demonstrated

DURING the present month the west of England has been much interested in demonstrations carried out by the Plymouth and District Gas Co. at Plymouth to show how pottery can be manufactured and fired by gas.

At Wembley last summer there was a pottery-making demonstration in which a gas-kiln was used instead of the immense furnaces of the Potteries, and it occurred to the heads of the Plymouth Gas Co. that what could be done in London could be done in the West of England. The operatives of the Wembley enterprise—Mrs. Shuffrey and her two daughters, of Chelsea—have been induced to reproduce their pottery-making demonstration at Plymouth in the production of vases, tiles, pendants, and other beautiful examples of ware. The potters' clays with which the ladies work is found in the neighbourhood of Plymouth—fireclays, ball clays, and China Clays. The potter's wheel and all the paraphernalia of a miniature pottery is seen, the chief interest of the experiment centering in the oven or kiln in which the shaped mould receives a first firing. It is then withdrawn, and the glaze applied by dipping or blowing, unless the ware has to be hand-painted, when the glaze is transparent, and it is afterwards returned to the kiln for the final firing at a temperature of about 1,040 degrees.

Advantages of Gas over Coal

One of the great advantages of gas is demonstrated in the kiln. With a coal furnace it is difficult to maintain an even temperature, and the ware has to be enclosed in order that it may not be chemically affected by the fumes and smoke, thus entailing loss of space, whereas a gas-kiln can be filled to its capacity. All dirt and smoke is eliminated, while the convenience of a gas over a coal fire can be readily appreciated. By this attempt to encourage the revival of pottery in Plymouth, history may be said to be repeating itself, for the introduction of hard-paste porcelain into this country was due to the ability and enterprise of William Cookworthy of Plymouth in the eighteenth century, who first made the discovery of China Clay in Cornwall and its suitability for the manufacture of porcelain. Cookworthy had to contend with many difficulties in those days that are not in evidence to-day, the firing of the ware so that it could be brought out of the oven bright and clear and unstained by smoke being one of the chief. The use of the gas oven obviates this handicap to a successful pottery, and had it been practicable in Cookworthy's day the venue of pottery manufacture might never have been removed from the West Country to Staffordshire. The success of the demonstrations at Plymouth may be the means of bringing a share of that industry back.

Using China Clay on the Spot

The possibility of reviving the pottery industry at Plymouth has been often mooted, but the explanation given as to why it could not compete with the present home of the Potteries has been that it is easier and more economical to take the China Clay to the coalfields than to bring the coal to the clayfields. To show that this handicap no longer holds is one of the objects of the demonstration now undertaken by the Plymouth Gas Co., whose chairman, Mr. J. H. Ellis, explains in the course of an interview with him on the subject.

"We have for a long time been of the opinion," he said, "that it is wasteful to send China Clay from the West of England to the Potteries and to have it brought back in the form of household utensils. We have also thought that if that could be avoided without altering the character of Plymouth by vitiating its atmosphere by turning out immense volumes of smoke, it would be a desirable thing in itself to establish potteries here and thereby re-create a local industry without interfering with present industries and amenities. In pursuit of that idea, the Company some years ago enabled Mr. Hoyte, an official of the Company, and myself to visit the Potteries and study the matter on the spot. In Stoke-on-Trent we found that gas firing had already received the attention of many interested in the trade, one of the main objects being to avoid the dirtying of the material by smoke. Our visit was made during the war and could not then be followed up, but seeing the demonstration of pottery manufacture and firing by Mrs. Shuffrey and her daughter at Wembley attracted our attention. We came to the conclusion that if these ladies could conduct their pottery under the limitations that obtained in London, it could be more advantageously done in Plymouth by reason of the price of gas being so much less here. Those ladies have shown that pottery manufacture can be a success with the material we have in the neighbourhood."

Showing the Way

Mr. Ellis pointed out that it is not the desire or intention of his Company to embark upon the industry, pointing out that their function was the production of gas and appliances for its use. "The Company cannot itself go in for China Clay or porcelain manufacture but it can supply appliances for these purposes. In the experiment we have undertaken our object has been to encourage local initiative. We have had many inquiries from manufacturers of useful articles to assist them in the manufacture of such articles on a large scale and we have offered them every possible facility. We do not wish anybody to embark on the industry unless it is proved that gas firing is both cleanly and economic. We are keeping

the most careful records of the cost of what we are doing and shall place the benefit of our knowledge freely at the disposal of all inquirers whether they propose to start on a large or small scale. It may well be that the old Plymouth china can be reproduced here in large volume."

Commenting on the possibilities, the *Western Independent*, Plymouth's weekly paper, says: "As to the primary question of production costs, people have been asking for many years why it is that China Clay mined in Devon and Cornwall has to be taken to the Potteries in Staffordshire to be made into ware. The answer has been that it is cheaper to take the clay to the coal than to bring the coal to the clay. If it can be shown that gas firing in Plymouth is as cheap and efficient as coal firing in Staffordshire, then that obection disappears. There is *prima facie* reason for supposing that if the Company can bring coal from Northumberland to Plymouth and make it into gas at a cheaper rate than gas can be produced at Newcastle—which is the fact—the gas firing of pottery in economic competition with coal firing is quite within the bounds of possibility."

The effect of pottery manufacture at the doors of the China Clay works of Devon and Cornwall would be very beneficial to China Clay producers, for present heavy costs of transport would be largely eliminated. The establishment of potteries in the West of England will therefore receive every encouragement from clay and china stone producers in these parts.

A China Clay "Pool"

How Shall Foreign Competition be Met?

As a result of the dissolution of the China Clay Producers' Association, and the need felt for some central organisation to concentrate efforts on counteracting the competition of foreign China Clays in overseas markets, attempts are being made to sense the attitude of producers and royalty owners towards a pooling arrangement via a capitalisation of the whole industry. The views of some of the leading producers on the subject, and the circumstances that have led up to a disposition to consider some such proposal may be summarised as follows:—

Although China Clay, or kaolin, was discovered in England towards the close of the eighteenth century, it only became used in considerable quantities towards the close of the nineteenth century. The early years of the twentieth century saw its maximum use, when nearly 1,000,000 tons was despatched from Cornwall and Devon annually. China Clay producing for many years was little known to those outside the sister counties. The developing and financing of clay pits was practically in the hands of local interests. The markets for the clay were controlled and developed by factors, or middlemen, who bought the clay at prices which left but small profit to the producer, and resold the product to consumers at handsome profit to themselves. This method of business pertains even to-day, but to a much lesser degree than formerly. It is surprising that development should have reached the proportions it did by 1913, and makes one wonder what could have happened had the industry been organised on efficient and unified business lines.

Effect of the War

When the Great War affected adversely so many industries the China Clay trade did not escape. At first, in 1914, the seriousness of the position was not realised. One producer, for instance, stated confidentially that three months, and at most six months, would see the end of any disturbance to the trade. The disastrous position in which China Clay producers found themselves is now a matter of history. All able-bodied young men were drafted from the clay districts, and shipments to many parts of the world were rendered impossible, and countries to which shipments could be relatively safely made called for reduced quantities. The man-power, so essential to the producing of China Clay, had been drained to the limit. These abnormal conditions and circumstances had many effects, direct and indirect, upon the industry. Users of China Clay in countries outside the British Isles wanted the material, and this was the opportunity for the enterprising man. Most countries have China Clay deposits from granite formations, although qualities and working possibilities vary. Fortunately for Cornwall and Devon, the best qualities found there have not been beaten or equalled, and the facilities for working and world-wide distribution have not been approached Nevertheless, great development of domestic clays other than English have taken place. This is the case in France, Denmark, Germany, Belgium, India, and Malay Straits, but more noticeable is the development in the United States of America.

Producers' Association

The war ravages upon the English trade brought together the individual producers, who spent many hours and days in discussions with intentions to find a solution for the betterment of conditions. Two schools of thought were at work; the one advocated taking the bull by the horns and without further delay creating one financial interest for the whole industry, this to include all the individual producers and individual royalty owners. The world strength of such a combination will be apparent to many. Artificial restrictions would to a large extent have been swept away, and greatly increased quantities sold by keeping costs down and selling at the low prices upon which the commodity depends for its market. This policy had serious consideration from some of the leaders of the industry; in the light of subsequent events and experience, had it been conformed to the future prospects of the industry would be brighter than they are to-day. The other policy advocated an association of producers for allocating market demands among members and the control of selling prices. This policy was, perhaps, a compromise, but was adopted at the end of 1917 by about 98 per cent. of the trade. For better and for worse the Association kept its course until mid-September, 1924. The actual financial benefit to members was undoubted, but the inevitable happened. An artificial organisation of this sort, through its dependence upon good-will rather than contract obligations, has a precarious and uncertain life, especially when it does not embrace the whole of the producers, thus giving the outsiders freedom to undercut the insiders at will, and by trading upon this advantage undermine the stability of the central organisation.

The Royalty Owners

The royalty owners were not a party to the old Association, but they were interested in its operations, inasmuch as the maximum revenue for their leases depended upon the quantity their particular lessees sold. The policy of the Association did not appeal to them as a whole, because there was always the feeling that in complying with the rules of the Association lessees working some properties were not disposing of so much clay as they might if they were free. That some organisation, embracing both the producers and royalty owners, is essential to the preservation of the industry is beginning to be realised, especially by the producers, who are up against the serious and growing competition of domestic clays in foreign countries, notably America, Czecho-Slovakia, Germany, and Northern Europe. It is a matter for wonder that the royalty owners have not realised the diminishing value of their interests, as the producers have already done, for the unorganised resistance to foreign competition is far more menacing and damaging than any restrictions exercised by the Producers' Association. The impetus given to production outside Cornwall and Devon has been largely due to the policy adopted and followed by producers and royalty owners in not realising that only by the pooling of interests can production costs be kept at such a level as to keep down the selling price so that production of foreign clays, which are more expensive to produce than our home clays, would be rendered unremunerative.

A suggestion in favour of the pooling of interests of the whole industry is being explored, and it is said that the largest producers are ready to consider it; but its success would depend upon the active co-operation of the royalty owners, whose interests are as much at stake as those of the producers. It would involve the capitalisation of the whole industry, with the retention of the existing producers and royalty owners in a managerial and proprietorial capacity.

Foreign Competition

Producers say that the menace of competition in all our overseas markets—European, Asiatic, and American—is growing, and the longer the industry delays grappling with it in a united fashion the more securely will that competition be established, and therefore the more difficult to meet. It is not too late for producers and royalty owners to get together for the protection of their own interests, but in another two or three years it will be. Here are the figures published by

the Department of the Interior in the United States, showing the production and sale of kaolin in the United States, 1914–1923. In ten years it has more than doubled :—

	Short Tons (2,000 lb.)
1914	150,519
1915	141,064
1916	201,157
1917	206,334
1918	179,694
1919	152,828
1920	268,203
1921	162,726
1922	275,675
1923	336,803

China Clay in 1924

A Comparison with 1923

BELOW we give dissected figures showing for the first time the China Clay trade to overseas and home markets during 1924 compared with 1923. Statistics relating to China Clay include china stone, which in the figures of total trade accounts for 50,127 tons in 1924 and 40,188 tons in 1923. It will be noted that while the total trade in 1924 was nearly 1,000 tons in excess of 1923, the export trade was over 92,600 tons greater, and the home trade over 21,700 tons less. The export tonnage was considerably swollen at the end of the year through overseas buyers taking advantage of the slump in prices that followed the dissolution of the Association. An analysis of the figures and the valuable lessons to be drawn from it by China Clay producers will be found on our editorial page.

COUNTRY.	1923. QUANTITY. Tons.	1923. VALUE. £	1924. QUANTITY. Tons.	1924. VALUE. £
Finland	10,763	21,276	9,976	21,239
Sweden	19,033	43,661	17,475	37,640
Norway	13,462	22,623	20,702	37,791
Denmark	2,923	8,032	3,616	10,135
Germany	6,735	24,285	19,742	48,822
Netherlands	22,121	55,146	34,534	84,154
Belgium	60,519	122,385	57,696	112,173
France	36,046	78,786	35,035	74,276
Switzerland	682	1,634	502	1,178
Spain	11,605	36,028	15,183	42,168
Italy	20,193	54,384	27,448	74,424
Japan	168	1,028	4	26
Dutch East Indies	—	—	322	1,293
Austria	98	320	—	—
Hungary	474	1,560	—	—
U.S.A.	286,405	680,515	331,900	761,728
Mexico	595	2,496	883	3,731
Argentine	385	1,721	1,571	5,373
Other South American States	134	607	110	541
Esthonia	1,116	2,226	1,891	3,448
Latvia	406	1,051	519	1,015
Poland	—	—	408	1,306
Other Foreign Countries	267	1,311	321	1,433
Total Foreign Trade	494,110	1,161,075	579,838	1,323,894
British—				
India	16,196	63,528	20,508	79,827
Canada	7,319	19,017	5,756	14,152
Newfoundland	2,489	4,600	2,802	5,157
South Africa	20	50	3,488	13,255
Australia	397	2,399	448	2,438
Channel Isles	—	—	395	889
Other British Possessions	215	777	155	565
Total British	26,636	90,371	23,552	116,283
Total Overseas Trade	510,746	1,251,446	603,390	1,440,167
Total Home Trade	277,118	678,939	255,352	606,410
Total Home and Overseas	787,864	1,930,385	858,742	2,046,577
Average Price per Ton	£2 9s. 0d.		£2 7s. 6d.	

Cornish "Cotton" in Artificial Silk

New Use for China Clay

THE successful development of a new process in the manufacture of artificial silk fabrics has just been revealed by Mr. Reville, the famous dress designer. The chief feature of interest to China Clay producers lies in the fact that it is described as "the new clay process." In the manufacture of cotton fabrics, China Clay has long been known to the trade as Cornish "cotton," and the extension of its use in the manufacture of artificial silk fabrics opens up great possibilities for the China Clay trade. Mr. Reville says the process "is likely to revolutionise throughout the world the supplies of moderately priced materials for women's wear." The background of the fabric is cotton, and the artificial silk is woven either into the material or in a design on the surface, with such skill and art that the material resembles something at least five times the price. "It will work out at about 5s. a yard," a Pressman was informed, "a price that brings an artistic silk frock within the reach of any girl whatever her circumstances."

The new process has now reached a commercial success only after years of research. The lustrous soft artificial silk is dyed to the right shade before it is made up with the cotton. After weaving the whole material is put into the dyeing vat, but by a clever scientific process the colour of the silk remains untouched, and only the cotton background changes colour. It is impossible with the naked eye to detect that the silk in these productions is artificial. The colour is the work of artists, and the finish the result of science. A piece of the fabric shown to Press representatives was a delightful shade of salmon, with little Mah-Jong emblems dotted at intervals in silk. Another, with a white background, carried a design from a frieze at the Parthenon in red and blue silk. Other designs were in beige, blue, and gold. The possibilities of the material cover a wide range of demand, including day and evening gowns, evening summer frocks, linings for fur coats and other wearing apparel. The fabrics are the production of British mills in Lancashire.

Mr. Reville declares that he has perfect confidence in the future of the productions from this new fabric, in which producers of China Clay should be keenly interested, as China Clay seems to be an integral part of the new process. Its development will be carefully watched by producers of China Clay.

The "Drawing" or Bucket Lift

As Used In and Around the China Clay Pits

By "China Clay Captain"

THE bucket lift pump was originally the main pump of the clay pits, but now it is seldom fixed as a permanent pump, the Cornish plunger or the modern centrifugal having taken its place. Nowadays it is chiefly used while sinking a very wet shaft when there is too much water for the kibble and barrel, though sometimes it is used as an emergency pump if the plungers go wrong.

When the plunger lift is "lost"—that is, when the valves are "chipped," or the doors and packing "blown" and the water has risen over the faulty part; in local phraseology the "lift is lost"—in such a case it is usual to drop another lift (a drawing lift) or put a bucket down the plunger column. Most pitmen place a working barrel just above the top-door piece, to be able to convert the plunger into a drawing lift, as it is seldom that both valves go wrong at once. Even if they do, a cheese-clack could be inserted between the joints.

This is not the only emergency pump, of course. The Pulsometer is sometimes swung in chains where there is a good boiler to supply steam, as it has a voracious appetite for steam. The centrifugal also, where electricity is available, is another, and even a Shand and Mason fire engine has at least been requistioned for one clay pit. There may be peculiar circumstances attending any breakage, which may make it desirable or expedient to use either of these pumps, but for use while sinking a wet shaft the old style drawing lift will take some beating. It has this advantage over most pumps —*it will work in fork, i.e.*, keep along pumping part air and part water. The miner just keeps the winebore in the lowest part of the shaft bottom and it draws away the water as it comes, so that he practically works on dry ground.

Then in blasting ground with a stout winebore and a proper

system of protection staying, it seldom gets blown up. Again, it helps to bring down pure air to the miners. Snorting and snoring away in fork it keeps the air circulating. Immediately after blasting, just by pulling the bag out of launder and letting the water pour down the shaft, it will soon clear away the smoke.

Description

The drawing lift is made up of the following parts beginning at the bottom with the winebore or snorer, screwed on the top of which is the clack door-piece; next the working-barrel, then the changing-door piece, followed by the column or rising-main. On the top is a short collar-launder with a duck-bag fastened to it with leather slips and clout nails. Down through of course are the bucket rods fastened together by clasp-joints, at the bottom end the bucket, at the top end a "sword-rod." All the joints between the parts are made with lapped rings, that is, a ring about one inch larger than hole in joint, made of iron 1¼ in. by ¼ in. wrapped around with strips of Balshag covered with Stockholm tar to preserve it. The bag at collar-launder, the sword of bucket rod, and the worm screw are all designed to keep the lift in working pitch while being gradually lowered through perhaps one fathom.

While it is seemingly rough engineering, yet it is admirably adapted for the purpose, and as I remarked at the beginning as a pump for *sinking* it is equalled by few and excelled by none.

China Clay Leases

The Incidence of Income Tax

At the St. Austell Rotary Club luncheon last month, Mr. John Keay, chartered accountant, gave an interesting paper on "The Origin and Development of Accountancy." In the course of it he had some interesting observations to make on the incidence of income tax, on its effect upon business men, and particularly in its operation in regard to China Clay leases.

In a reference to Inspectors of Taxes and the present administrative system of taxation, he stated that "in theory the system was good, and in practice so far as large businesses were concerned it worked admirably; but no body of men was more fully aware than chartered accountants of the large section of taxpayers made up of the comparatively small business men. It was on this class that the Income Tax Acts operate most harshly. In England one could carry on a business or trade without keeping books, on the Continent it was quite the opposite. It was unfortunately a trait in the character of the small business man that he strongly objected to keeping books. The experience of the lecturer, however, lead him to believe that this was not a wilful characteristic, but rather a temperamental one. As a result the Revenue were not supplied with accounts, or even if accounts were supplied in many cases they were not perhaps quite accurate.

The income tax procedure, where accounts were not supplied, was to estimate the amount of profits. Sometimes the calculation was based upon an estimated amount as returned by the taxpayer, and at other times it was based upon the Revenue's own ideas as to what the business ought to make. In nine cases out of every ten the assessment made and the actual profits did not agree. If the assessments were more than the actual profits, the taxpayer had to bear all his own costs of an appeal, in spite of the fact that the appeal was made necessary through the Revenue over-assessing the amount of the profits. On the other hand, where the profits proved to be more than the assessment the Revenue took steps to go back over a long period of years, and to recover by way of penalties the tax which had been lost.

China Clay Leases

Mr. Keay expressed the view that if book-keeping was made compulsory the Bankruptcy Acts would not require such a complete overhauling as many people thought they did to-day. After referring to loopholes in Company Law, of which an insolvent trader could take advantage for the purpose of defeating his creditors, Mr. Keay went on to refer to a glaring injustice so far as it affected the income tax position of the staple trade of the neighbourhood, namely, the China Clay industry. "You are all possibly aware," he said, "that a large majority of the clay works in this neighbourhood are worked under the leasehold system, and it often happens that a lease of, say, 50 years, is purchased for a sum of money, say, for instance, £50,000. It follows that the lease decreases in value each year as the lease expires, and at the end of this term the £50,000 has been lost should the superior landlord refuse to continue the lease. Now for income tax purposes the Revenue will not allow any depreciation in value of such a lease in arriving at the profits for assessment for income tax, so that the individual, firm, and company owning the lease is really taxed upon the original capital. It seems to me that if £50,000 is paid for the right to work and get clay out of a certain piece of ground, what has actually happened is that the clay in that ground has been purchased for £50,000, and the amount of profits that such a works should be taxed upon is the difference between the £50,000 plus the cost of getting and marketing such clay, and the ultimate price obtained. This injustice, however, does not apply to this district only, but also to coal mines, salt mines, tin mines, quarries, etc."

Tax Official's View

In the discussion, Rotarian H. R. Purchase, District Surveyor of Taxes, remarked that the difficulty in dealing with the question of allowing depreciation for wasting assets like leases was to provide a formula that would meet all cases equally, instancing the case of the wastage in income-earning capacity of lives, which were a wasting asset as much as leases, and would have an equal claim for an allowance for depreciation as expiring leases. It was the business of the Revenue to see that incomes liable to tax contributed to the revenue no matter from whatever source they came. As to whether the revenue was income was the real test for taxation or not.

China Clay Accountant's View

As a postscript to Mr. Keay's remarks, Mr. Ernest H. Fryatt, chief accountant for the English China Clays, Ltd., stated that "As a rule leases on clay property are not granted for a lump sum payment. It is true that the lease is granted for a number of years, say, 50. At the end of the lease a further lease is granted without any payment. But to get back to Mr. Keay's point. Suppose a lease was granted for 50 years, and the lessee sold the lease, say, after 10 years, for £50,000. Would Mr. Keay be willing to pay income tax on this profit of, say, £40,000. As the income tax law stands at present this is a 'capital' gain, and not liable to tax. Per contra, 'capital' losses by way of amortisation, etc., are not accountable to tax. The question of amortisation of leases is an old one, and there are too many difficulties in the way of ever getting an allowance for income tax purposes without adopting the principle of taxing capital gains. I am quite sure the China Clay lessees would lose heavily. Who is to say how many years a clay works will last?"

Another comment on the question raised by Mr. Keay was that it had always been a matter of considerable concern for China Clay producers, through the Revenue authorities refusing to allow any reduction from profits for the depreciation in the value of leases. It did seem strange that while firms were allowed depreciation on plant and machinery and other equipment they were refused a similar concession in regard to leases, which became of less value as the expiring date approached. The view of the authorities seemed to be not that a case could not be made out in favour of the allowance, but that the difficulty of finding a formula that would meet other cases equally calling for a concession presented insuperable difficulties. Mr. Purchase's point that an equally good case could be made out for individuals to be allowed depreciation through their earning capacity becoming less as they advanced in years was ingenious, and at first sight seemed logically sound. But could it be said that the Revenue authorities did not to some extent recognise the justice of the case for individuals for some allowance, inasmuch as premiums paid for life insurance policies were deducted from income in arriving at the amount of tax the individual was liable for?

China Clay Worker's Presentation

At a luncheon given last week to the staff of Grose and Stocker, China Clay merchants, of Stoke, Mr. Tom Masters, of Hartshill, was presented with a cheque and also a solid silver tea and coffee service to celebrate the completion of fifty years' service as cashier to the firm.

China Clay Notes and News

English China Clays, Ltd.

A payment of a dividend on the cumulative preference shares at 7 per cent. per annum for the half-year ended December 31, 1924, has been made by English China Clays, Ltd., to holders registered on January 24, 1925.

Busy Paper Mills

Mills in the North of England making pure M.F. and S.C. printing papers are said to be very busy and unable to promise quick delivery for new orders. Much of this is for export. Mills in the South are also busier than they were but not so full of orders as those in the North.

China Clay Producers in Freemasonry

With the retirement of W. Bro. E. J. Hancock from the Worshipful Master's chair of St. Austell Peace and Harmony Lodge, Bro. W. H. Bettison, rate collector and clerk to St. Austell Parish Council, has become W.M. He is succeeded in the Senior Warden's chair by Bro. G. M. Johnson, who in the ordinary course of events will become Worshipful Master of the Lodge next year. Bro. Johnson is well-known in China Clay circles as a director of Varcoes China Clays, Ltd. He is a highly respected Freemason and is much esteemed by his Brethren of Peace and Harmony Lodge. W. Bro. J. W. Higman, J.P., a prominent figure in the China Clay trade, is one of the veterans of the Lodge. He has been associated with it for fifty years.

Ball Clay Industry

Unlike China Clay, ball clay is used practically exclusively in the pottery trade, and its production is almost entirely confined to the counties of Devon and Dorset, none being produced in Cornwall. In recent years China Clay producers have been paying more attention to the production of ball clay also, as it is found an advantage for firms to be in a position to supply all classes of clay and stone required by the potters. There has been considerable development by China Clay firms of ball clay deposits in Devon, quantities of it being now regularly dispatched through China Clay ports. Our monthly returns only show the quantities so dispatched. In Mid and North Devon an increasing number of men are employed in the production of ball clay, the method of handling is much improved and facilitated by the introduction of up-to-date machinery. Annual returns show that it is a growing industry.

Tehidy Minerals Prospects

The financial writer in *Truth* says: Tehidy Minerals shares are receiving attention once more and the price is up to 8s. against only 5s. not long ago. In view of the rise in the price of tin and of the increased production of certain Cornish mines, it is surprising that the market in these shares did not wake up sooner. South Crofty and East Pool are the principal payers of royalties on black tin and arsenic to Tehidy Minerals, but they are not the only contributors of revenue to the Company, which has minor tin rights, and also extensive China Clay interests. The principal of the latter, the Halviggan property, which yields high-grade clay, is being sold to the Cornish Kaolin for cash, and Tehidy will, I understand, continue to draw royalties on the production from this property. Altogether, the position of Tehidy Minerals is sounder than for some time past, and the prospects of the Company obtaining a substantial revenue are distinctly brighter. Any further rise in the price of tin or recovery in the prices of arsenic and China Clay will mean a further addition to this Company's growing royalty receipts, and this possibility lends some speculative attraction to the shares, which, although above the worst, are still obtainable at a big discount.

China Clay in Petroleum Industry

The absorbent, purifying, and bleaching action of good China Clays has been known for many years to the animal and vegetable oil refiners in the south of France, notably at Marseilles. Recently its use has been extended to the petroleum industry.

When agitating a refined and well-dried China Clay with mineral oil fractions, a considerable clarifying and bleaching action results. The spent clay so used can be recovered and re-used after calcination. A more important factor is the property of China Clay to absorb emulsifying sulphur containing impurities which pass into the oil when the latter is treated with sulphuric acid, followed by alkali, during the refining operations. If left in the petrol or paraffin burning oil or in the lubricating stock, these alkali sulphonates cause difficulty in oil separation and treatment, while the finished product is still far from standard—the petrol fraction leading to corrosion in the engine exhaust, due to sulphur compounds, and the burning oil giving rise to quickly spoiled wicks. These difficulties are effectively disposed of by the agitation of the acid and alkali treated oils with China Clay, the harmful sulphonates being absorbed and retained by the China Clay. There should be great scope for a considerable extension in the use of China Clay for this purpose when its clarifying and purifying qualities become better known to mineral oil refiners.

Port of Amsterdam

The following facts about the port of Amsterdam, which is much used for the shipment of China Clay to industrial areas in Northern Europe, should prove interesting to China Clay producers and shippers. Though the port of Amsterdam is actually on the Zuider Zee sixteen miles from the sea, it is reached from the North Sea through the canal which starts at Ymuiden. The depth of the North Sea Canal is 32 ft., and the locks at present are just large enough to allow a vessel of 722 ft. in length to pass up to Amsterdam. The record year for the port of Amsterdam was 1913, when the tonnage was 4,347,370. This figure is slowly yet surely being reached again. The permanent level of the navigable channel to Amsterdam guarantees a safe entrance independent of high or low water, and a further advantage is that the entire length is lighted at night. Two electrically-operated revolving bridges span the canal. They can open in 1½ minutes and allow a free passage of 164 ft. They are closed only on the approach of a train—to be exact 15 minutes before a train is due—and are immediately re-opened when the train has passed. No single revolving bridge equals them in size in Europe. When closed by ice, the navigation channel is re-opened and kept open by powerful ice-breakers. The cost of the canal, including maintenance, has so far reached the sum of £7,000,000. In view of all the facilities of the port, it is not surprising that several big firms have established their works there.

British and Foreign Ships at Fowey

At the last meeting of Fowey Borough Council, ALDERMAN SHADWELL presented the annual report of the Fowey Port Sanitary Authority, in which it was stated that the number of vessels using the ports of Fowey and Looe during 1923 was 1,515 both foreign and coastwise, representing a tonnage of 391,123. Of these 257 were engaged in the foreign trade, representing a tonnage of 108,831, and 1,258 were engaged in the coastal trade, representing 282,892 tons. Numerous sanitary defects had been notified and remedied and notices served to the number of ten. There had been no cases of infectious diseases within the port area during the year. The isolation hospital had been found in good order in spite of the wet weather. The rough seas had tended to undermine the landing slip, which needed repair.

The SANITARY OFFICER'S report was on the same lines, but he had classified the vessels using the port in their different nationalities, which Alderman Shadwell thought might be interesting to the meeting. The British ships headed the list with 687, other countries being represented as follows: Swedish, 56; Belgian, 44; Dutch, 41; Danish, 38; German, 35; French, 19; Irish Free State, 14; Japanese, 16; Esthonian, 10; Norwegian, 15; other countries, 20; including America, 1.

DR. F. CANN, M.O., referring to the prevalence of small-pox in different parts of the country, advised anyone who would be likely to do any travelling to be vaccinated. Fortunately the South was as yet free from disease, but he urged vaccination as a valuable safeguard.

China Clay Workers' Breach of Agreement

Mr. W. Rose presided at the annual meeting of China Clay Employers' Federation held at St. Austell last month, and Mr. J. W. Higman and Mr. John Lovering were re-elected Chairman and Vice-Chairman for the ensuing year. Messrs. John Hooper, H. Nicholls, R. Martin, W. T. Lovering and H.

Stocker were re-elected members of the Joint Industrial Council. Mr. E. J. Hancock wrote resigning from the Federation in respect of the Companies he represented. This created a vacancy on the Joint Industrial Council in respect of the other five members, and Mr. W. Rose was elected in his stead.

Discussion ensued over the refusal of some of the China Clay workers, especially the older ones, to accept the stipulation embodied in the agreement made by the Joint Industrial Council by both sides of the industry that all clay workers should work an extra half-hour on five days of the week in order to leave at one o'clock on Saturdays. It was stated that the younger men were in favour of the arrangement so as to enable them to go to football matches on Saturday afternoons. The older men were refusing to work the extra half-hour because they preferred the old arrangement of six days of seven hours, including Saturday afternoon's working. The Council considered it was a breach of the agreement that was made by both sides at the Joint Industrial Council at the instance of the men's representatives. It was decided to take no action in the matter at present and to defer further consideration of it until April when the agreement would be coming up for review, the six months' period for which it was to stand expiring in May.

China Clay Case Settled

A case was down for hearing at Bodmin Assizes before Mr. Justice Roche, on February 6, in which it was alleged that China Clay had been delivered that was inferior to the grade of clay bought.

When the case—Cornish Meledor China Clay Co., Ltd., *v.* Skynner and Higson, St. Austell—was called, Mr. R. E. Dummett, for defendants, said that the case had been settled. Plaintiffs won in the claim for £492 15s. 4d., and defendants were awarded the counter-claim for £445 8s. 4d., plaintiffs to pay costs. The statement of the case showed that defendants denied that they were indebted to plaintiffs for £492 15s. 4d., or that the consignment of clay was sold or delivered to them as alleged. Plaintiffs on or about March 20, 1924, loaded at Fowey about 259 tons 7 cwt. of clay which was not Meledor Clay No. 1, nor Cornish Meledor bleaching clay, but was clay known as No. 2 clay, or mica clay, and was of inferior quality and different from the clay that had been ordered. By telegram, dated March 20, 1924, whilst plaintiffs were engaged in loading the clay, defendants, having ascertained the facts, refused to accept the clay then being loaded, and warned the plaintiffs that in loading it they were acting on their own risk. Notwithstanding such a telegram plaintiffs insisted on loading the clay at Fowey and despatching it to the defendants at a cost to defendants of £130 for freightage, which the defendants had had to pay. In these circumstances the defendants claimed that they were under no obligation to accept or pay for the clay.

In support of their counter-claim, defendants contended that they had suffered damage by reason of plaintiffs' breach of contract or warranty, and failure to supply them with clay of the description or quality agreed or fit for the purpose for which it was sold. Mr. J. L. Pratt was for plaintiffs.

China Clay M.P.'s Statements

Mr. George Pilcher, M.P. for the Penryn-Falmouth Division, in the course of a tour of the division, which includes the China Clay area, delivering speeches on politics and on various local industries, made one or two inaccurate deductions relative to the China Clay trade.

Speaking about the China Clay trade with Russia and those parts of Russia which are now separate states, he made the remarkable statement that very little China Clay used to go to what is at present Soviet Russia, and that practically as much China Clay is now going to those states which have been carved out of Russia as went to Russia before the war. It is evident that Mr. Pilcher did not ascertain the facts before making such a public statement. The official returns of the China Clay trade with Russia refute Mr. Pilcher's statement and the deductions he made from it, for before the war Russia took in 1912, 45,779 tons of China Clay, in 1913, 40,377 tons, in 1914, 34,438 tons. The best years since then have been 1923, when there went, mainly to Finland, Latvia, and Esthonia, formerly parts of Russia, a total of 10,285 tons, and in 1924, 12,688 tons, quantities far below the pre-war totals that went to Russia. Equally misleading were Mr. Pilcher's remarks relative to the disparity between the freights for China Clay traffic to America compared with those to home destinations. He stated that the cost of transport of China Clay to New York was 15s. per ton and to the English pottery district 26s., comparing the rail cost to destination in the latter case to the sea cost to port in the other. He omitted to explain that the reason why American steamers take China Clay at such a low rate is because they take China Clay as ballast in the absence of other cargoes back to America, and that after the China Clay reaches port it has to bear rail charges inland. In the case of the home market, comparatively small quantities of China Clay go to the Potteries at the 26s. rate Mr. Pilcher mentioned, the bulk of it going by sea to Runcorn, Preston, Garston and neighbouring ports, the freight on which is 8s. per ton, the cost thence to the Potteries being about 6s. per ton. So it is not correct to compare the sea freight to New York with the rail freight to the Potteries in the circumstances prevailing. In making these observations it is not suggested that the rates for the home China Clay traffic are not too high.

Fowey Harbour Dredgings

Cornwall Sea Fisheries Committee having intimated to Fowey Harbour Commissioners their revocation of permission to dump dredgings and ballast from the harbour in Lantick Bay about a mile away, the Commissioners last month held a commission with fishermen as to the most suitable place for such deposits. The meeting unanimously decided in favour of continuing to use Lantick Bay, it being stated that that place had been spoilt for fishing, and that to go elsewhere would only mean further damage to fishing ground.

Colonel Edward Treffry was voted to the chair, and Sir ARTHUR QUILLER-COUCH, Chairman of the Harbour Commissioners, said the Commissioners were empowered to protect the access to the harbour and the discharge of ships in connection with the discharge of close on 1,000,000 tons of China Clay annually, representing £2,000,000 sterling to the China Clay industry of Cornwall. As ships had increased in size and draught the Commissioners had had to deepen the access, and by dredging operations between 1897 and 1922 they had discharged 860,000 tons of mud from the harbour at a cost of £25,000. In 1911 it was agreed with the Cornwall Sea Fisheries Committee in a friendly way that they should continue to use their old dumping area of Lantick Bay. In 1921 the Commissioners had a new Order, which contained a clause which they considered would enable them to dump where they chose, but they did not want to use that power arbitrarily, as the purpose of that meeting indicated. However, they went on peaceably depositing their mud in this area. Then on a foggy day last March two of their employees were fairly caught by the fisheries officers scraping out a certain amount of mud outside the area. As a public body responsible for the shipment of 1,000,000 tons of dead weight they thought they should have been consulted, but there was no consultation and no warning; the men were prosecuted and fined, and each party was told to pay his own costs. As a result of that action Cornwall Sea Fisheries Committee had told them that as from January 1 they revoked their permission to dump in the area in the public interest. What other public interest could there be than the access and discharge of 1,000,000 tons of cargo and the interest of the fishermen?

Mr. R. VINCENT spoke of the importance of not making it more expensive for shipping to come there, as would be the case if ballast had to be taken further out to sea, and Messrs. J. P. CARTER and F. A. HOBBS, speaking on behalf of shipping and shipbrokers, urged that the use of Lantick Bay ought to be retained in the interests of the port and of the fishermen.

Mr. WALTER H. GRAHAM, Clerk to the Commissioners, stated that the matter was before the Board of Trade Mercantile Marine Department, which knew what was going on. The channel had been dredged to about 18 ft., and if funds would allow the Commissioners wanted to go another two feet and so bring more ships there. They had to put the material somewhere, and if the area was continued in use he thought the Commissioners would see that the deposits were more evenly distributed. It was decided that the area previously fixed was the best in the public interests that could be allotted for the deposit of Fowey Harbour dredgings, but the Commissioners were asked to see that the deposits were spread equally over the allotted area.

Shipping and Export News of the Month

We give below the latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—January, 1925

Arrived.	Name.	Sailed.	Destination.
Jan. 1,	S.S. *Orleigh*	Jan. 5,	Ridham
Jan. 1,	S.V. *Paquerette*	Jan. 5,	Nantes
Jan. 1,	S.V. *Naiad*	Jan. 5,	North Fleet
Jan. 3,	S.S. *Pylades*	Jan. 7,	Bo'ness
Jan. 3,	S.S. *Girasol*	Jan. 8,	Runcorn
Jan. 4,	S.S. *Claretta*	Jan. 9,	Leith
Jan. 4,	S.S. *Ortona*	Jan. 6,	Barrow
Jan. 4,	S.S. *Elizabetta*	Jan. 9,	Gravelines
Jan. 5,	M.V. *Innishannon*	Jan. 9,	Rouen
Jan. 5,	S.S. *Atlantic Maru*	Jan. 21,	Philadelphia
Jan. 5,	S.S. *Ribblesdale*	Jan. 9,	Ridham
Jan. 6,	M.V. *Hope*	Jan. 6,	Polperro
Jan. 6,	M.V. *Mayblossom*	Jan. 6,	Polperro
Jan. 6,	S.S. *Elvington*	Jan. 13,	Brussels
Jan. 6,	M.V. *Liesbet*	Jan 10,	Terneuzen
Jan. 6,	S.S. *Pamela*	Jan. 14,	Glasgow
Jan. 7,	S.S. *Clydeburn*	Jan. 14,	Antwerp
Jan. 7,	S.S. *System*	Jan. 12,	Gravesend
Jan. 7,	S.S. *Blush Rose*	Jan. 9,	Hull
Jan. 7,	M.V. *Diligent*	Jan. 7,	Looe
Jan. 7,	M.V. *Mayblossom*	Jan. 7,	Polperro
Jan. 7,	S.S. *Guelder Rose*	Jan. 12,	Rouen
Jan. 7,	S.S. *Clyde Valley*	Jan. 14,	Fleetwood
Jan. 8,	S.V. *Snowflake*	Jan. 20,	Pentewan
Jan. 8,	S.V. *J. H. Barrow*	Jan. 9,	Par
Jan. 9,	S.S. *Patrino*	Jan. 16,	Tayport
Jan. 9,	S.S. *Mellanear*	Jan. 15,	Antwerp
Jan. 9,	S.S. *Whinhill*	Jan. 13,	Liverpool
Jan. 9,	S.S. *Bruxelles Maritime*	Jan. 15,	Antwerp
Jan. 9,	S.S. *Berkelstroom*	Jan. 17,	Amsterdam
Jan. 10,	S.S. *Shoreham*	Jan. 17,	Preston
Jan. 11,	S.V. *Narma*	Feb. 1,	Genoa
Jan. 11,	M.V. *Annen*	Jan. 17,	Harburg
Jan. 11,	S.S. *Ellen*	Jan. 20,	Genoa
Jan. 11,	S.S. *Brookside*	Jan. 17,	Bilbao
Jan. 12,	S.S. *Jern*	Jan. 21,	Drammen
Jan. 13,	S.S. *Sagenite*	Jan. 20,	Weston Point
Jan. 13,	M.V. *Elbnymphe*	Jan. 14,	Aberdeen
Jan. 13,	S.S. *Magrix*	Jan. 15,	Par
Jan. 15,	S.S. *Glenrose*	Jan. 20,	Sunderland
Jan. 15,	S.S. *T. P. Tilling*	Jan. 20,	Runcorn
Jan. 15,	S.S. *Jolly Charles*	Jan. 21,	Ridham
Jan. 15,	S.S. *Ferndene*	Jan. 26,	Antwerp
Jan. 15,	S.S. *Haarfagne*	Jan. 21,	Odense
Jan. 15,	S.S. *Mersey*	Jan. 22,	Manchester
Jan. 17,	M.V. *Antigoon*	Jan. 28,	Rouen
Jan. 17,	S.V. *Mary Barrow*	Jan. 27,	Par
Jan. 17,	S.V. *Raymond*	Feb. 4,	Erith
Jan. 17,	S.V. *Water Witch*	*	Weston Point
Jan. 17,	S.S. *Sutton*	Jan. 27,	Gravesend
Jan. 17,	S.V. *Minerva*	Feb. 11,	Christiansand
Jan. 18,	S.S. *Jenny*	Jan. 22,	Savena
Jan. 18,	S.S. *Liguria*	Jan. 26,	Philadelphia
Jan. 19,	S.S. *Western Ocean*	Jan. 29,	Portland, Me.
Jan. 20,	S.S. *Dragoon*	Jan. 26,	Liverpool
Jan. 20,	S.S. *Norfolk Maru*	Feb. 4,	Portland, Me.
Jan. 20,	S.S. *Hans Gude*	Jan. 27,	Philadelphia
Jan. 22,	S.S. *Alice*	Jan. 27,	Preston
Jan. 22,	S.V. *William Ashburner*	Jan. 27,	Charlestown
Jan. 22,	S.S. *Clara Monks*	Jan. 27,	Runcorn
Jan. 22,	M.V. *Norma*	Jan. 29,	Bergen
Jan. 22,	M.V. *Hope*	Jan. 23,	Plymouth
Jan. 23,	S.S. *Pengam*	Jan. 29,	Brussels
Jan. 23,	M.V. *Lydia Cardell*	Jan. 27,	Plymouth
Jan. 23,	S.S. *Velocity*	Jan. 24,	Par
Jan. 23,	S.S. *Edith*	*	
Jan. 23,	S.V. *Zampa*	*	Stettin
Jan. 23,	S.S. *Londoner*	Jan. 29,	Antwerp
Jan. 23,	S.S. *Sophie*	Jan. 30,	Genoa
Jan. 25,	S.S. *Cromwell*	Jan. 30,	Preston
Jan. 25,	M.V. *Hamme*	Feb. 3,	Harburg
Jan. 25,	M.V. *Katie*	Feb. 4,	London
Jan. 26,	S.S. *Gothia*	Feb. 4,	Boston, Mass.
Jan. 27,	S.S. *Arclight*	Feb. 3,	Rouen
Jan. 27,	M.V. *Drogden*	Feb. 4,	La Pallice
Jan. 27,	S.S. *Scartho*	Feb. 3,	Gothenburg
Jan. 27,	M.V. *Lynetten*	Jan. 31,	Rouen
Jan. 27,	S.S. *Falmouth Castle*	Feb. 3,	Weston Point
Jan. 28,	S.S. *Westdale*	Jan. 31,	Liverpool
Jan. 28,	S.S. *Isabella*	Feb. 4,	Terneuzen
Jan. 28,	S.S. *Elloughton*	Feb. 5,	Antwerp
Jan. 29,	S.V. *Erhardt*	Jan. 30,	Looe
Jan. 30,	S.S. *Shellie*	Feb. 5,	Glasson Dock
Jan. 31,	S.S. *Ohio Maru*	Feb. 12,	Philadelphia
Jan. 31,	S.V. *James Milton*	Feb. 4,	Bridgwater
Jan. 31,	M.V. *Yealm*	*	Pentewan

* Signifies "In Port."

Charlestown Shipping—January, 1925

Arrivals

Date	Vessel	From
January 1	*Snow Queen*	Penryn
January 5	*Prutan*	Porth
January 6	*Western Lass*	Firth
January 6	*Garibaldi*	Newlyn
January 9	*Balfron*	Guernsey
January 9	*Oxbird*	Penryn
January 13	*Fal Castle*	Firth
January 16	*T. W. Stuart*	Firth
January 17	*Esperanto*	Exmouth
January 18	*Abercraig*	Dartmouth
January 20	*Guardian*	Porth
January 21	*Edern*	Porth
January 23	*Lady Daphne*	Truro
January 25	*W. M. Ashburne*	Cardiff
January 27	*Greenhithe*	Exmouth
January 28	*Noah*	La Rochelle
January 28	*Pickmere*	Barny
January 29	*Oarsman*	Truro

Sailings

Date	Vessel	Destination
January 1	*Paquerette*	Nantes
January 1	*Naiad*	London
January 3	*Snow Queen*	Runcorn
January 9	*Prutan*	Terneuzen
January 10	*Balfron*	Preston
January 12	*Vera*	Kirkaldy
January 13	*Garibaldi*	Nantes
January 13	*Oxbird*	Rochester
January 15	*Fal Castle*	Runcorn
January 17	*Western Lass*	Rochester
January 20	*T. W. Stuart*	London
January 20	*Esperanto*	Antwerp
January 23	*Abercraig*	Preston
January 23	*Guardian*	London
January 24	*Edern*	Barrow
January 30	*Oarsman*	London
January 31	*Lady Daphne*	Rochester
January 31	*Greenhithe*	London
January 31	*W. M. Ashburne*	Rochester

Par Harbour Shipping—January, 1925

Arrivals

Date.	Vessel.	From.
January 7,	*Mary Waters*	Falmouth
January 9,	*Hope*	Looe
January 9,	*J. H. Barrow*	Fowey
January 10,	*Idvos*	Fowey
January 10,	*Triumph*	Plymouth
January 11, S.S.	*Ebbrix*	Falmouth
January 12,	*Diligent*	Mevagissey
January 12, S.S.	*Treleigh*	Looe
January 15, S.S	*Teign*	Plymouth
January 16, S.S.	*Magrix*	Fowey
January 17, S.S.	*Snow Queen*	Plymouth
January 17,	*May Blossom*	Plymouth
January 20,	*Pet*	Falmouth
January 23, S.S.	*Velocity*	Newport
January 23,	*St. Michael*	Runcorn
January 24, S.S.	*Alder*	Southampton
January 24, S.S.	*Audux*	Plymouth
January 24,	*Kate*	Plymouth
January 24, M.V.	*St. Austell*	Plymouth
January 24,	*Mary Barrow*	Fowey
January 28,	*Rosina*	Plymouth

Sailings

Date.	Vessel.	Destination.
January 10,	*Hope*	Fowey
January 12, S.S.	*Ebbrix*	Gravelines

January 15, s.s.	*Teign*	Penarth
January 16,	*Diligent*	Mevagissey
January 16, s.s.	*Treleigh*	Garston
January 20,	*May Blossom*	Plymouth
January 21, s.s.	*Snow Queen*	Garston
January 23,	*Ideros*	Gravelines
January 23,	*Triumph*	Plymouth
January 23, s.s.	*Magrix*	Grimsby
January 26, s.s.	*Velocity*	Newlyn
January 27,	*Mary Waters*	Ardrossan
January 27,	*J. H. Barrow*	Glasgow
January 27,	*Pet*	Rochester
January 27, s.s.	*Alder*	Runcorn
January 30, s.s.	*Audux*	Grimsby

Par Harbour Tide Table, February, 1925

(Greenwich Meantime Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Saturday	21	3.40	4.12	12.6
Sunday	22	4.41	5.7	13.3
Monday	23	5.32	5.56	13.7
Tuesday	24	6.19	6.40	13.11
Wednesday	25	7.0	7.19	13.11
Thursday	26	7.37	7.54	13.7
Friday	27	8.12	8.29	12.11
Saturday	28	8.46	9.3	12.1

E. CLEMENS, Harbour Master.

China Clay Exports

RETURN showing the exports of China Clay, the produce or manufacture of the United Kingdom from the United Kingdom to each country of destination registered during the month ended January 31, 1925.

COUNTRY OF DESTINATION.	QUANTITY Tons.	VALUE £
Finland	183	412
Norway	2,632	3,298
Denmark	5	13
Germany	1,650	3,882
Netherlands	2,892	6,204
Belgium	4,729	7,520
France	4,349	8,085
Spain	748	2,041
Italy	1,629	3,356
United States of America	22,827	48,159
Mexico	50	210
Brazil	2	8
Argentine Republic	5	25
Irish Free State	11	36
Nigeria	—	1
Transvaal	1	20
Bombay, *via* other ports	1,731	6,845
Madras	45	194
Bengal	353	1,425
Australia	43	260
New Zealand	1	6
Canada	43	78
Total	43,929	92,078

January China Clay Deliveries

THE deliveries of China Clay, china stone and ball clay by China Clay firms during January reveal a substantial improvement on those for December, China Clay deliveries showing an increase of nearly 10,000 tons and reaching within 6,000 tons of the best of the last six months. The detailed figures for the month and comparisons with the corresponding month of last year, together with the returns for the previous four months, are appended :—

Port.	China Clay. Tons. 1925	1924	China Stone. Tons. 1925	1924	Ball Clay. Tons. 1925	1924	Total Tons. 1925	1924
Fowey	59,942	43,844	2,428	3,604	2,990	1,282	65,360	48,730
Charlestown	5,690	3,603	—	—	—	—	5,690	3,603
Par	3,231	2,169	43	326	—	—	3,274	2,495
Plymouth	1,445	1,393	35	48	60	285	1,540	1,726
Looe	84	—	—	—	—	—	84	—
Penzance	—	1,060	—	—	—	—	—	1,060
Rail	5,098	4,617	—	—	—	—	5,098	4,617
January	74,490	56,686	2,506	3,978	3,050	1,567	81,046	62,231
December	—	64,860	—	2,613	—	3,083	—	70,926
November	—	71,546	—	3,912	—	1,238	—	76,696
October	—	80,197	—	3,693	—	2,821	—	86,711
September	—	74,157	—	4,368	—	3,342	—	81,868

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

CENTRAL CORNWALL CHINA CLAY CO., LTD., St. Blazey. Registered January 6, £1,800 debentures, part of amount already registered; general charge. *£24,950. May 1, 1924.

JONES (SAMUEL) AND CO., LTD., London, E.C., paper makers. Registered January 8, £550 and £550 mortgages, to Borough of Watford; charged on 45 and 47, Sandringham Road, Watford. *£12,000. May 15, 1924.

NEW BIRCH TILE CO., LTD., Hanley. Registered January 17, £1,200 (not exceeding) mortgages, to Bank; charged on property in Clarence Street, Hanley. *£1,600. April 19, 1923.

REDHILL TILE CO., LTD. Registered January 21, £250 and further sums not exceeding in all £1,000 mortgages, dated January 1, 1925, to Miss L. J. Churchman, 42, Hurst Road, Horsham, and another; charged on properties at Salfords, Horley. *£4,500. January 5, 1925.

TRENT PAPER MILLS, LTD., Manchester. Registered January 13, £120,000 debentures (filed under section 93 (3) of the Companies (Consolidation) Act, 1908), present issue £12,000; general charge. *——. July 8, 1924.

TRENT VALE BRICK AND TILE CO., LTD., Stoke-on-Trent. Registered January 22, £3,000 first debentures, to G. A. Eastwood, Brambling House, Chesterfield, railway wagon builder; charged on Trent Vale Brick and Tile Works, Penkull, etc.; also registered January 22, £2,500 second debentures; general charge (subject to first debentures).

WITCHAMPTON PAPER MILLS, LTD. Registered January 14, £10,000 debentures, to W. Burt, Witchampton, paper manufacturer; general charge.

Satisfactions

BATH VICTORIA BRICK AND TILE CO., LTD. Satisfaction registered January 16, £500, balance of amount outstanding July 1, 1908; also registered January 19, £700, registered September 2, 1913.

NEW BIRCH TILE CO., LTD., Hanley. Satisfaction registered January 21, £800, outstanding July 1, 1908.

PEARSON (JAMES), LTD., Chesterfield, pottery manufacturers. Satisfaction registered January 8, £1,000, part of amount registered February 6, 1920.

Cornish Ketch Wrecked at Thames Mouth

ON February 11, as the result of heavy gales, the ketch *Rosina*, of about 57 tons, which was bound from Par, Cornwall, to London, with a cargo of China Clay, was discovered driven on a shoal at the mouth of the Thames. She had been anchored in the Downs, and during the night the anchor parted and she was swept on to Barrow Sands. The Margate lifeboat was the first to reach the spot, but she grounded. While she was getting off the Clacton lifeboat was able to take off the four men composing the crew of the ketch.

The men, who were landed at Clacton later wet through, said they burnt flares to attract attention, and after these had given out they ignited anything inflammable they had, including some of their clothing. The ketch was waterlogged, and they expected to be washed overboard with the rising of the tide. The ketch is expected to become a total wreck.

China Clay Imports for January

A RETURN showing the registered imports of China Clay (including china stone) into Great Britain and Northern Ireland reveals the fact that there was none during the month of January, 1925.

The China Clay Trade Review

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America and the Export Trade

THE importance of the markets for home China Clays in the United States is fully appreciated by English producers, and is a source of increasing interest by reason of the fact that last year the largest quantity on record was taken in a single year by American buyers. The subject of the development of American domestic clays and their ability to oust our clays from American markets is consequently a fruitful source of discussion among China Clay producers on both sides of the Atlantic. Recently, as will be found fully reported in this issue, Mr. J. W. Higman—whose firm has for a great number of years done business in the States, and who is thoroughly familiar with the markets there, having paid repeated visits to America—dealt with the subject at the St. Austell Rotary Club, of which he is the President. As regards the deposits of China Clay in the Southern States of America, where most of the mines are located, the possibilities of China Clay production are unlimited, but as Mr. Higman pointed out for the consolation of China Clay producers, China Clay production in America is subject to limitations which do not apply to English China Clay production.

English China Clays Different

IN the first place, American China Clays not only differ in their characteristics from English China Clays, but are inferior to them. Moreover, except in the case of industries situated in proximity to the mines, the railway transportation costs from the mines to northern industrial areas especially those adjacent to the Eastern and Western seaboards, are so heavy that they cannot compete with the English China Clay as regards price. Therefore, English China Clays have two distinct advantages in their favour over American domestic clays produced in the Southern States, namely, better quality and lower price. While the American China Clay deposits are situated many miles inland away down south, the Cornish and Devon deposits are adjacent to the seaboard and can be carried to American ports for 15s. per ton. The American ports being comparatively near to the consuming areas, while those consuming areas are very far distant from the American China Clay mines, it follows that the English China Clay merchants have not such heavy transportation costs to meet as American China Clay producers. Therefore, while English China Clay producers cannot hope to overcome competition from American clays in those industrial areas near to the American domestic clay mines, they are in a position to compete successfully in industrial areas more remote from the American mines, and where the demand is very considerable.

American Labour and Transport Difficulties

MR. HIGMAN also showed that the American producers have the Labour question and a shortage of rolling stock at certain seasons of the year to contend with. That may make it more difficult than ever for them to keep down their production costs. Such is Mr. Higman's conviction as to the indispensability of the better qualities of English China Clays for both coating and potting purposes that he has no fear of their being eliminated from the American market by the competition of domestic clays. In fact, he stated that he could not find that American potters are using more than a small percentage of domestic clays in their china "bodies," the American clays not possessing the plasticity and firing qualities that English clays possess.

English Clays Essential to American Users

THAT English China Clays are maintaining their markets in the United States, even though large quantities of domestic clays are being used, is seen by the fact that last year the huge quantity of over 331,000 tons was exported, while in 1923 286,000 tons was exported. The pre-war annual tonnage taken by America was about 250,000 tons. It is clear that American paper-makers and potters must have our China Clays, and as the industries in which English China Clays are used are important from a manufacturing point of view, American paper-makers, potters, and other users are likely to offer the strongest resistance possible to any attempt that may be made to increase the tariff against English clays in order to protect the American domestic clays.

Coincident with the growth of the English China Clay imports fostered by American buyers, there have been developed in the States great industries, particularly that of coated paper-making, which would not have been possible without English China Clay. Two factors have combined to favour English China Clays, and in favouring them have favoured American industries—continuity of supply and low transportation costs—two factors that no tariffs can ever effectively encompass to make it worth while for the American legislature to bolster up domestic clay producers. As regards factor No. 1, English China Clay is produced all the year round in unlimited quantities, and as regards factor No. 2, can be delivered to its destination whenever it is wanted at low cost, two dependable factors that do not apply to the American product, even if it possessed, which it does not, the characteristics of the home product. The low freight of 15s. per ton to ship China Clay from Fowey to American ports is due to the fact that China Clay is carried as ballast as a return cargo for ships bringing profitable food and raw materials cargoes to this country from America.

Higher Tariffs Would Penalise America

TAKING these and other circumstances into consideration, American China Clay producers can never hope to compete with English China Clays on equal terms, either in quality or price. To counteract the advantages that English China Clays possess by artificial means would only result in increasing the cost to American manufacturers, to whom English China Clay is an essential raw material in the manufacture of goods, not only for home consumption, but for export. Both American buyers of English China Clays, who have built up a big merchanting business, and the American industries that draw their supplies from them or direct from English producers, should have no difficulty in making out a case against any attempt on the part of American China Clay producers to raise the tariff against English clays.

English and American China Clays Compared

Impressions of a Home Producer

THE members of the St. Austell Rotary Club, at whose recent luncheon several China Clay merchants were present, heard from the President, Mr. J. W. Higman, J.P., a prominent China Clay merchant and head of the firm of J. W. Higman and Co., of St. Austell, an interesting address on American China Clays. His observations were the result of a visit of inspection which he paid to the China Clay mines, situated mainly in South Carolina, Georgia, Virginia, and Pennsylvania. His first visit was to properties at Sumter, in South Carolina, where for the first time he became acquainted with the deposits of American domestic kaolins or white clays.

"I found," Mr. Higman said, "that the average depth of over-burden varied from 10 to 12 ft., which was removed by steam shovel. The bed of clay at the most important work was uncovered sufficiently to produce about 4,000 tons of crude clay, of a depth varying from 16 to 20 ft. This was wrought by coloured labour, the clay either being dug out by picks or loosened by heavy iron wedges being driven in, the crude clay containing about 2 per cent. only of grit. This was loaded into train wagons similar to those in use with us, and drawn by locomotives to a large shed about 500 yards distant, where it was placed on racks to be sun and air dried,

MR. J. W. HIGMAN, J.P.

in fine weather, in two or three days. The crude clay is conveyed mechanically to a crusher which breaks it up into small pieces, and thence drops into the washing cisterns.

Preparation Different From Home Clays

"In these cisterns it is disintegrated by revolving knives, working on a horizontal shafting, up to which level the water is constantly kept. It is then forced through an outlet into a smaller tank through a fine mesh, where the final washing is completed, and the liquid clay is again forced through this cistern into a third, whence it is pumped up through a conveyor pipe to what they denominate 'troughs,' really similar to our 'micas.' At this particular mine there were about 150 ft. run of these, five runs of 30 ft. each, thence into settling vats, just similar to our pits. These held about 20 tons each, being five in number. The clay usually settles in 24 to 48 hours, sufficiently so to be dealt with by the filter presses. Of these at this particular mine there were eleven, each one being capable of turning out about 4½ tons daily. On leaving the presses the clay is conveyed by trolley to the drying racks, twelve in number, all heated by the exhaust steam through about 2 in. galvanised pipes; each rack had six runs of pipes, with a width of about 8 in. vertically, and measure about 4 ft. square.

HARD ROCKY-LOOKING FORMATION OF BED OF CLAY IN SOUTH CAROLINA.

Two or Three Days to Dry

"From two to three days is sufficient to dry the clay to the proper degree of dryness, then it falls into a sort of V-shaped trough, in which an endless conveyor takes the dry clay to a bucket conveyor, which deposits it to the overhead floor, whence it is laden into the railroad cars, which run in on tracks right alongside the shed, similar to the trucks for loading clay direct from our own kilns. The power at this mine was produced by horizontal engine of 100 horse power, steamed by two boilers at a working pressure of 100 lb.

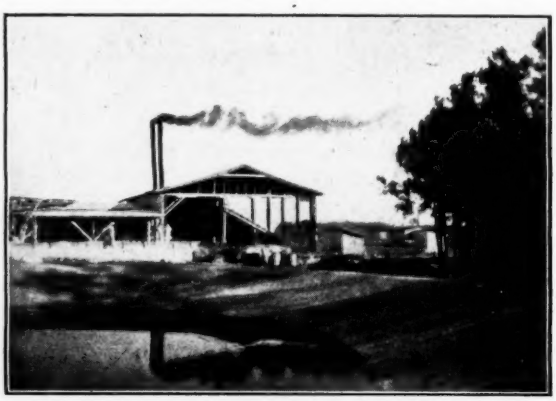
Ten Hour Day

"The working day commences at 7 a.m. and continues until 6 p.m. with one hour for dinner, or in other words a ten-hour day. The rate per hour for labour here was 32 cents, approximately 1s. 4d. The area of this particular property is about 120 acres, and boring results show it is all a practically clay-producing property. Other mines in this State which were visited were only producing crude clay, to which the same description would apply.

Georgia Clays Discoloured

"On leaving Sumter, I proceeded to Augusta, Georgia, and visited several mines in this State. The greater proportion, however, are producing only crude clay, in one large mine they were raising about 60 tons a day with a labour strength of 40. Here the over-burden in some parts was over 20 ft. deep, and seemed to be impregnated with some red organic matter. This clay was also removed by steam shovel, and dealt with in the same way as our own.

"A large bed of clay, estimated at 16 ft. deep to produce four to five thousand tons, was visible here, of good quality



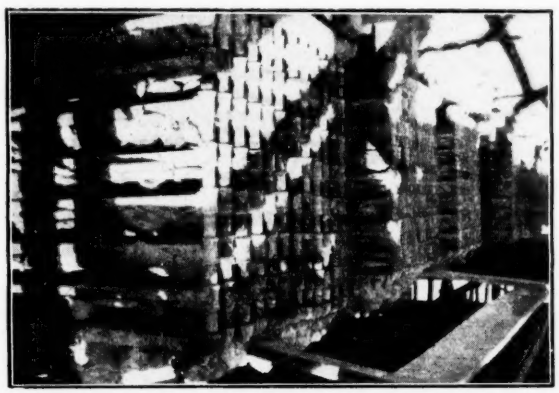
WASHING PLANT IN SOUTH CAROLINA, WHERE CLAY IS TREATED AFTER IT IS MINED AND CRUSHED

clay, containing about 98 per cent. clay. The clay was taken by mules and carts to the drying sheds on the high ground and placed on racks to be air dried; this is effected in a few days The dry clay is then beaten up into small pieces, and shipped direct into railroad cars.

Pulverised Clay

"Other large plants, not far from Augusta, but across the River Savannah, and in the State of South Carolina, were visited. The larger portion were producing crude clay, but one property I visited and inspected, by the courtesy of the owners, was much deeper and of far greater area. Here a very large quantity of over-burden had been stripped, the depth varying from 40 to 60 ft. Here the clay was not shipped in its crude state, neither was it washed, but after being sufficiently dried in the sheds, it was conveyed to the pulversing plant, which brought it down almost the same as flour.

"After being so pulverised, the fine clay was driven along a species of conveyor, with square openings at the bottom, strong paper bags to hold 50 lb. each, were placed underneath and inserted over the openings, which were about 6 in. square, there being six of these. The bags were then weighed, strongly fastened up by cord, and run down a shoot, either direct into the railroad cars, or otherwise, as required. The capacity of this plant was 25 tons of pulverised clay daily. Another mine near, working under the same conditions as the first, was able to produce about 60 tons a day of washed clay.



DRYING RACKS IN SOUTH CAROLINA HEATED BY EXHAUST STEAM, ON WHICH CLAY IS DRIED AFTER WASHING PROCESS.

A crude producing clay mine was also visited, adjoining the two above. Here also a fine bed of clay was uncovered of from 14 to 16 ft. deep, daily production about 60 tons.

Prices of Crude, Washed, and Pulverised Clay

"Another large property near Maconga has a large bed of clay of still greater depth, producing about 50 tons of crude clay daily. The average price of crude clay varies from 7 dollars to 9 dollars per ton free on rail at the mines, and washed clay from 10 dollars to 12 dollars free on rail at mine, and pulverised from 9 dollars to 11 dollars, f.o.r., cost of bags extra."

The conclusion Mr. Higman formed after careful investigation of the various properties visited, which varied from 120 to 200 acres in extent, was that the possibilities of American domestic clays were great. He referred to the present crude methods of production and to the necessity of the clays being efficiently washed before larger quantities will find a ready market, especially amongst the paper-makers.

Mr. Higman continued: "I also visited other clay producing properties in Pennsylvania State and Virginia to which my previous remarks also apply. These clays are termed sedimentary clays, derived from feldspar originally contained in granite, and weathered through the processes of decomposition.

Quantities in Paper-making

"The largest tonnage of American clays used in the paper industry are mined in Georgia and South Carolina. During 1915 the production in these two States amounted to approximately 92,000 tons, and in 1916 to 125,000 tons. The production of American has gradually been increased for use in the

FORMATION OF CLAY BED IN GEORGIA.

paper industry, until in 1916 more than 200,000 tons were mined, of which the greater portion were used in paper manufacture. During the years 1916 and 1917, more than 250,000 tons each year were imported from England. During the years 1917 and 1918, there has been a great reduction in the production of American clays, owing to transportation problems and lack of labour. During the period of the war, labour conditions made it impossible to obtain more than 33 per cent. capacity of clay plants, whereas the normal capacity of the American clay plants is more than 385,000 tons.

English China Clays Superior

"I think it cannot be denied that English clays, which are dried by evaporation, are superior to the American, which are pressed and consequently hard. I have no fear that the better qualities of English clays will be eliminated, especially for both coating and potting purposes, as I cannot find in the latter that American potters are using but a small percentage of domestic clays in their 'bodies.' The producers of American clays are prepared to show (1) that the sales price in the U.S. of the domestic clays are higher than the sales prices in the U.S. of the imported clays; (2) that the sales prices of clays produced in England for exportation to the U.S. at the mines in St. Austell, Cornwall, England, are considerably less than the prices of similar domestic clays at the principal mines in Georgia. Before the war the English clays practically controlled the U.S. markets, but during the war the clay beds of the U.S. were developed to an extent never before known in the history of this industry in the United States.

Labour Costs Difficulty

"From personal information gained in the cotton plantations, the wages for black labour have risen considerably in the past few years, and the clay beds being in the Southern States for the most part, the price of labour has also affected the cost of producing domestic clays, the younger generation of negroes being now well educated, they are more inde-

CRUDE CLAY LOADED IN RAILWAY WAGONS IN GEORGIA.

pendent and migrate in large number to the Eastern States, where distinctions of colour do not exist. The question of the production of American clays may become of vital importance to English clays, especially as regards those similar in quality to American domestic clays."

Home China Clay Trade Advantages

Mr. E. J. Hancock, managing director of West Carclaze China Clay Co. and other China Clay producing firms, said they were very much indebted to Mr. Higman for his interesting address. He went on to say that there was no such China Clay as English China Clay, and the deposits found in America were primarily sedimentary clays and were not like their own clays which were washed out in situ. At the present time there was much greater consumption of paper in America, the increase in the production of books and periodical literature being tremendous. When they remembered that one-sixth of the book paper consisted of china clay, they could see how great the demand was likely to be. The fact that the American china clay mines were so remote from the great industrial centres gave English China Clays an advantage in regard to freights. The fact that the freight on clay shipped from Fowey to American ports was only 15s. per ton helped the home China Clay works every time.

Mr. Hancock referred to the fact that at certain periods of the year the rolling stock on the American railways in Southern States was required for the conveyance of cotton and chickens, the transport of clay from the mines having then to take second place, which handicapped the continuity of the supply of American clays. The transport difficulty, coupled with the supply of labour, were difficulties that handicapped American china clay production. He did not think they need worry very much about the competition of American clays in the main centres of the paper-making mills in America, which were a long railway journey from the clay mines in the Southern States.

Essential Characteristics

Speaking generally, the clays of America were not exactly the same as English China Clays, except in very few cases, being different in texture and requiring different treatment. As long as men in mid-Cornwall would do a fair day's work for a fair day's pay, and they could transport the clay cheaply to Fowey and thence to American ports, there was a great future before the West of England China Clay industry, although at the present time the profit was low. He emphasised the fact that Cornish China Clay was different from any other clay, being finer in texture, and so long as the American buyers could obtain English China Clays cheaper than any others he submitted that there was no danger to the English China Clay industry.

Mr. W. Rose, of the firm of North and Rose, said no doubt there were certain characteristics about the Cornish clays which were absent very largely from the American clays, and which made the English clays superior.

Mr. Higman said there was no doubt about it, and no buyer handling the two clays had any difficulty in coming to the conclusion that they were nothing like the same. He likened the American clays in their marketable state to crude chalk, and it looked like it, and the reason it could not be used to any great extent in pottery was because it had not got the plasticity that English China Clays possessed.

In moving a hearty vote of thanks to Mr. Higman, Mr. J. C. Hubbard said they were all indirectly, if not directly, concerned in the prosperity of the China Clay industry, and would find the information given both helpful and useful.

Filter Presses in China Clay Works

FILTER presses in connection with the production of China Clay have been installed as part of the plant of China Clay works only to a limited extent, but consequent upon recent signal successes with filter presses of big capacity in a few works, China Clay producers are directing more and more attention to this means of quick and economical production. Two factors highly commend the introduction of this plant—the speedier preparation of the clay between the pit and the dry, and the lessened consumption of coal per ton of clay dried. Some remarkable results have been achieved by English China Clays, Ltd., through the installation of filter press plants on a fairly large scale.

China Clay Traffic on Cornish Roads

Rural Council Hints at Extreme Action

A LIVELY correspondence has taken place between the Clerk to the West Penwith Rural Council and Colonel J. M. Findlay, secretary of the Porthia China Clay Co., operating in West Cornwall, in which the former complains of the manner in which the company's motor lorries carrying the clay have cut up the roads, and the latter retorts that the roads are so bad that the expense of maintaining transport vehicles renders it probable that the industry will have to close down.

The clerk (Colonel T. H. Cornish) informed the West Penwith Rural Council that he had written Colonel J. M. Findlay (secretary of the Porthia China Clay Co.), pointing out the serious position which had arisen through the damage done to roads in Towednack and Lelant by lorries hauling China Clay to the ports of export. A feeling existed, the letter said, that the clay works were showing great indifference to the welfare of the inhabitants of the district affected and to the ratepayers of the area of the Council. That the roads had been cut to pieces there was not the slightest doubt, and the drain on public resources was fast approaching a position which would cause a storm of indignation from Hayle to Land's End, and public opinion might be so strong that the Council would be forced to seek remedies that would be undesirable from many points of view. The Council had on two occasions requested the clay works to advise them of the roads which they proposed to use, and it was regretted that the request had been met with silence. It was with astonishment the Council learnt that the lorries had begun to use the road passing through Brunion ; this road for some miles in length was showing signs of giving in, and two bridges had been broken down. The Council were most anxious to avoid any serious trouble, and thought that if a conference could be arranged, at which the owners of the clay works would be present, an understanding and agreement could be arrived at, which would not hamper the development of the clay pits, and reduce the expenses to the ratepayers in the area of the Council.

China Clay Companies' Standpoint

Colonel Findlay replied that there was no doubt that the roads were in a deplorable condition. It was also probable, from the way in which, in places, they were repaired, that much expense would be avoided if they were put in such condition as would reasonably adapt them to modern transport. If the Council appreciated the enormous cost of upkeep of transport appliances which this deplorable condition and improper method of maintenance imposed instead of suggesting wilful misuse they would have reason to wonder that users were so patient. As to the storm of indignation, it seemed probable that if the Council failed to maintain properly the roads so that the resources of the district might be developed, it would lead to the curtailment or even closing down of an important industry, as the present enormous cost of maintaining transport over such impossible roads seriously indicated. It seemed, therefore, that this storm of indignation would be directed rather against the Council. It did not appear that any conference would materially further the matter. Either suitable road facilities must be available or the works must be closed. How far the throwing out of work of over 50 men in such circumstances would be agreeable to the district was left for the Council to estimate. It was not possible to limit the transport to any particular roads, as deliveries had to be made at the various ports and railway stations. In view of the fact that over £200 per annum was paid in licences by and in connection with the clay works, the Council would appreciate the fact that there was a very substantial contribution paid yearly by the company to road upkeep.

The Council decided to send a deputation to the Ministry of Transport, Captain Denis Shipwright, the husband of Sir Edward Hain's daughter, to represent the Porthia Co., of which he and the Hain family are the chief proprietors, in regard to a grant towards re-conditioning the roads.

The company have been beset with obstacles in regard to the transport of their product, the St. Ives Council, it will be remembered, having objected to the use of St. Ives harbour because it was alleged it would interfere with the fishing industry and the amenities of the place as a holiday resort.

"The Teagle": Its Uses in Clay Mines

By "China Clay Captain"

For raising the "dirt" while sinking a shaft—unless in the case of a large engine shaft, when a steam hoist is installed and a corner of the shaft "cased in" to make a skipway—the usual apparatus is the teagle and kibble—in other words, the windlass and bucket. The "teagle" (perhaps a corruption of tackle) consists of a barrel, stands, brace board, frame, stays, and platform with rope and kibble. The wood barrel is generally 6 ft. long, diameter from 6 in. to 9 in., with a handle at each end made of 1 in. round iron, the purchase or radius of handle path being from 12 in. to 15 in. The stands also of wood are mortised into a foot piece keyed and stayed at their bases, and kept firm and the right distance apart by the brace board, into which is dovetailed a slide to act as a catch to keep the kibble swinging in any part of shaft when not in use.

Formerly hemp ropes were favoured, of from 1¼ in. to 2 in. diameter, but during the last 20 years the ⅜ in. flexible steel wire rope has nearly everywhere taken its place. The "teagle-haler" (the local name for manipulating this machine is haling teagler) has found that it is easier to pull a "10 score" man out of shaft with a rope 7/16 in. radius than with one with ¾ in. Other advantages are that a longer rope may be wound on the barrel, and wire, of course, is stronger than hemp. The method of attaching the rope to kibble varies. It may be by "cup and shackle" or a spliced thimble or, as formerly, the hemp rope is attached by the kibble-knot. It was a test, this knot, in the old days to tell if a man was a miner or not. It is really a simple thumb-knot turned around the bow of the kibble handle so as to grip the end like a blackwall-hitch. If properly tied and the end "moused" down to the handle, it is as good, if not better, than the thimble or shackle, because it allows the kibble to come right up to the barrel, whereas the splice of thimble or cup, if very long, strikes the barrel, and if the clearance for landing is limited gives undue strain to the rope end. This causes it to fray out, thus weakening it, besides making it nasty to handle because of broken wires.

When the shaft gets down 30 ft., if not before, two kibbles are used; or if a wet shaft, a barrel one end of rope and kibble the other. It makes it much easier for the top-man and it also saves time, because the empty kibble goes back while the full one is coming up; also the weight of the empty one helps to pull the full one up, as is very evident when the empty reach the bottom and there are a couple of rounds more to wind, which is about the usual to give slack for tipping. About 4 ft. up from kibble a piece of hemp rope is tied by a clove hitch to the teagle rope for lashing tools, timbers, etc.

A story is told of a teagle-haler who placed the bottom ends of six laths (wood 7 in. by 2 in. by 5 ft.) in the kibble, and, while trying to lash them, slipped the end of lashing. The laths spread-eagled, and being top heavy, upset the kibble, and all fell down the shaft ten fathoms below. The old miner below heard them coming, and crouched in a corner; luckily they missed him. The top-man, horrified at what he had done, could hardly speak, but just managed to gasp out, "There they be, Jan!" "All right!" came the laconic reply, "send down the rest," just as if nothing unusual had happened.

Many tales are told of the simplicity or duplicity of teagle-halers. It is recorded of one fellow that, while pulling up a miner who had displeased him, when about half-way up he shouted down, "Hold on a minute, I want to spit on my hands." Of course the poor miner went down again, like Paddy came down from Cork, with a run.

I myself had a curious experience while sinking a trial pit in a clay bottom to ascertain if the clay was holding down or not. Miners being scarce and my job slack I took on a shift sinking a cupboard binding shaft. We were working three shifts, owing to having cut a large quantity of water. One afternoon, when down about 40 ft.—it had been a very busy afternoon, with clay "soft enough to split"; it had been more than a barrel of water to a kibble of muck, and my top-man, an elderly man, had been winding like blazes practically all the afternoon, in fact he had to, or we should not have sunk anything—just before, four o'clock, I had been fixing a sett, perhaps it took about five minutes to trim and jamb it back, and by that time the water was nearly over my washer's boots. I shouted up, "Lower the barrel," but could get no reply. On looking up I could see the man gripping the handle, his face set and drawn, the colour of clay. I kept shouting at intervals for perhaps five or ten minutes; it seemed longer to me. Meanwhile the water kept creeping up. I had made a little platform with the pick, shovel and bar, to prevent it getting over the top of my boots. After the above time had elapsed, I saw the man begin to shake and twitch, and rub his hand across his forehead. I shouted again, and, believe me, he looked in all directions before he looked down the shaft. Then he spoke and said: "Hullo! Who's down there?" I said, "You know who's down here; it's so-and-so," giving my name. "No!" he said, "never heard your name before." "Well, I'm blowed!" I ejaculated. Remember I was down near seven fathoms in a wooden box 5 ft. by 3 ft., with water rising, and not a soul near except apparently a lunatic, who might fall down on me. Yet it struck me so funny that the man who had been working with me for a week, and had some three hours before lowered me down, and every now and then during the afternoon been shouting down, "Purty lot of water, edn there" now didn't know me, had never heard my name before! Well, I had to laugh, and nearly fell off my temporary platform. However, not knowing what else to do, I asked him if he could pull me up. He replied, "Yes, certainly!" I put one foot in kibble, and with the other tried to catch all the joints in the timber in case I had a quick run back. All went well, though, and getting another man after "crib" I finished my core all right. I learned afterwards that the old man was subject to epileptic fits and was totally unfit to have another man's life in his hands.

These stories go to show that the top-man should be as carefully chosen as the miner below.

Ball Clays for Refractory Materials

A recent paper read before the Society of Glass Technology drew attention to the need for good refractory materials. Although much had been done to improve and render more uniform the fireclays now employed, it was important to examine other material likely to give better results. The authors, A. Cousen and Professor W. E. S. Turner, referred to the uses of sillimanite, and on the subject of bonding their researches had shown that, with ball clay as a bonding agent, good results were found when a proportion of 15 to 30 per cent. of bond was employed. The porosity of hand-moulded specimens was inversely proportional to the amount of bonding agent used, and with the addition of 30 per cent. of ball clay reached as low as 22 per cent. Test slabs, both with 15 and 30 per cent. of bond, withstood a larger breaking load than fireclay slabs, after firing at 1000 to 1400°, but after heating to 100° or 800° the clay slabs gave superior results. Stourbridge clay gave a less plastic mixture, which gave on firing to 1400° a more porous texture than equivalent mixtures in which ball clay was used. The Stourbridge clay mixtures, however, gave promise of producing quite good results when moulded into shape under pressure. Bentonite did not justify its employment as a bonding agent.

In a second paper by Messrs. F. G. Clark and W. J. Rees reference was made to the distinct advantages of sillimanite as a glass works refractory, as molten glass made very little attack upon it.

The best results had been obtained with sillimanite bonded with from 10 to 25 per cent. of ball clay. A covered pot had been made from 25 per cent. ball clay mixture, soaked for four weeks before use. This pot was 43 in. high and took 15 days to make. Its cost was greater than that of the ordinary fireclay pot, but longer life in the furnace and freedom from pot stones would compensate for this. The material was also recommended for rings floating in the glass and for bottoms of tank furnaces. Its thermal conductivity was higher than that of fireclay. The authors considered this mixture of sillimanite and ball clay the best refractory material yet known for use in the hottest part of a glass furnace.

China Clay Notes and News

Death of China Clay Cooper's Wife

The death has occurred at Charlestown of Mrs. Rowse, wife of Mr. John Rowse, principal of the firm of John Rowse and Son, China Clay coopers. Mrs. Rowse, who had been an invalid for some time, was a staunch member of Charlestown Parish Church, and an active worker in connection with its social activities.

Clay Wagoners Fined

Three China Clay wagoners were concerned at St. Austell Petty Sessions this month. Alfred Woolcock, junr., was fined 7s. 6d.; James Tregidga, 10s., and Thomas Hancock, 5s., for carrying loads of China Clay to Charlestown exceeding the weight they were allowed with the tyres they were using. P.C. Osborne, Charlestown, said that six wagons were weighed and four were over weight. The plea was that the Clay was heavier than the wagoners realised.

Electric Light and Power for Fowey

At the Fowey Town Council meeting this month, it was reported that a deputation from the St. Austell Electric Light Co., Ltd., had been received and that the lighting company had submitted a scheme for the provision of power and lighting for the whole area, with a power station at Par. It would take 12 months to complete, if sanctioned, and would supply power at a rate of 10d. per unit, as compared with 7s. 6d. per thousand cubic feet of gas. The difficulty was to get a power station at Fowey.

Fowey Regatta

At a public meeting presided over by the Mayor (Mr. George Varcoe, Junr.) to consider the running of the Royal Regatta this year, the hon. secretary called attention in his report to the lack of financial support from the inhabitants of Fowey. A sum of £70 was received from vice-presidents, etc., and less than £8 from door-to-door collection, the remainder of the total being made up by receipts from dances, sale of flags, etc. There was a debit balance of £10 19s. on the year's working. It required about £170 to run the day's sport. The meeting was adjourned to ascertain whether financial support was forthcoming to run the regatta this year.

New China Clay Company

Great Rosemellyn China Clays, Ltd. (204,301), registered March 6, 1925.—To acquire the sett or licence to dig, work, search for, raise, cleanse, and make merchantable, and to carry away and dispose of all China Clay and china stone that can be found under certain lands forming part of an estate called "Rosemelling," Roche, Cornwall, granted by an indenture dated August 12, 1924, and made between Colonel Sir William Serjeant of the one part and C. R. Skynner of the other part. Nominal capital, £30,000 in £1 shares. Permanent directors: C. R. Skynner, The Villa, Charlestown, St. Austell; H. W. Gould, 2, Bedford Circus, Exeter (chairman). Qualification of directors: £500 shares or stock. Remuneration of C. R. Skynner £100, of H. W. Gould £200 per annum.

Mr. Skynner is well known in the Potteries, and is connected with the St. Austell China Clay merchanting business of Skynner and Higson.

Presentation to China Clay Captain

A very pleasing ceremony took place recently at Trethosa on the occasion of the retirement of "Captain" Daniel Bassett, of E. C. Clays, Ltd., after half a century's connection with the Trethosa Clay Mine. Mr. Samuel Jacobs, one of the employees, on behalf of his fellow clay workers presented Captain Bassett with an ebony, silver-mounted, walking stick inscribed with his initials; also a pair of slippers. Mr. Jacobs said they desired to show their appreciation and esteem for the good will and amicable relationship that had always existed between them, and hoped that Captain Bassett would live long to enjoy his retirement. Mr. John Wallis, P.C., also spoke as one of the oldest employees. Captain Bassett suitably responded.

The new "Captain" (M. Arthur), formerly of N. Carloggas, said that it was hard to follow a Daniel, but he hoped the good will that had existed between them and Captain Daniel would continue to the benefit of all concerned.

China Clay in Artificial Marble

Specifications for a new patent (221,857) have been lodged for the manufacture of artificial stone or marble and the production of articles therefrom. W. H. Clegg and G. Whittaker, 18, Exchange, Huddersfield, Yorkshire.—For the purposes of the invention use is made of finely divided sulphur and siliceous sand, the latter being cleaned from all impurities and free from chalk, lime, or other compounds of calcium. As an alternative, finely divided China Clay, or iron or steel slag may be employed. In certain cases, asbestos fibre in a finely divided condition can be used. Suitable proportions for general use are about equal quantities by weight of the sulphur or of the sand and/or other materials. The sand is thoroughly dried and mixed with the sulphur. The mixture is then heated in a suitable apparatus, preferably in a jacketed pan containing a heavy oil with a high flash-point, so that it will not readily ignite. The pan is treated by an easily regulated method. The use of an oil-jacket ensures an even temperature all round the mixture in the inner vessel, and minimises loss of heat by radiation. A suitable cover is provided to the pan to prevent free access of air to the heated mixture. The mixture is raised to a temperature of about 400 degrees centigrade, and maintained at this heat for a period of several hours, during which it is frequently stirred. Generally speaking, a minimum heating period of six hours is required to ensure the complete absence of air bubbles, and consequent freedom from blowholes of articles produced. Any desired colouring matters may be added.

China Clay Merchants in "The Gondoliers"

Last month, the St. Austell Amateur Operatic Society gave a series of brilliant performances of Gilbert and Sullivan's *The Gondoliers* throughout a whole week to crowded and appreciative audiences. It was declared to be the best they have yet done. Several of the actors, directly or indirectly connected with the China Clay trade, were in the cast, Mr. C. C. Cornish, a China Clay merchant, and Mr. F. S. Liddicoat, European representative of the Paper Makers' Importing Co., of America, well-known in China Clay circles, successfully taking prominent parts. Their performances were commented on thus in the local Press:

"The sombre, austere character of Don Alhambra, otherwise the Inquisitor, was undertaken by Mr. Cornish in a manner that heightened the brutal humour of the part and added one more mark to his established reputation as an actor, with a clear diction that gets his words over the footlights with telling effect and with no doubt as to their meaning. His interpretation was a notable success. Guiseppe, one of the two Gondoliers around whom the opera revolves (Mr. F. S. Liddicoat), was one of the heaviest male parts and made great demands upon the memory and vocal powers. Mr. Liddicoat proved his worthiness for a big part by his success as both actor and singer, his situations being marked by spirit and his dialogues by effective elocution. His appreciation of the playfulness of his part contributed much to its entertaining character."

The closing performance was characterised by scenes of great enthusiasm. Many presentations of bouquets and boxes of chocolates and cigarettes were made to the principals. Mr. J. W. Higman, J.P., president of the Society, said that he had never seen such an amateur performance excelled, and it reflected great credit upon the artistic talent of St. Austell.

Old China Clay Captain's Death

The death at Beam, Bugle, last month of "Captain" Tom Pascoe, at the age of 73 years, removes a well-known figure in China Clay circles. He had been captain of the English China Clay's Wheal Hope China Clay Works for 42 years, and was very prominently associated with the work of the Bugle United Methodist Church. The esteem and respect in which he was held was fully shown by the large and sympathetic attendance at the funeral. The Rev. Edwin Hortop, who officiated, said they had lost a friend and brother beloved; a gracious and noble personality whose character and worth was recognised, and whose example should be an inspiration to others. The deceased would be much missed in the home, at the works, and in the services and work of their church, to which he had been one of the best of friends, and a trustee

for nearly 40 years. The principal mourners present were Mr. W. Pascoe, Mr. E. Pascoe, Mr. H. Pascoe (sons), Mrs. R. Payne (daughter), Mrs. W. Pascoe and Mrs. H. Pascoe (daughters-in-law), Mr. R. Payne (grandson), Messrs. F. Julyan, T. and P. Prout (cousins), Mr. Bartlett (Callington), Messrs. T. Pascoe, G. Pascoe, and P. Pedlar (nephews), Capt. E. A. Hooper, and Capt. S. Pascoe (friends). Included in the very large and representative attendance were several representatives of the China Clay trade: Messrs. E. Vian and Alfred Davies (representing English China Clays, Ltd.), Mr. Tom Nicholls (Hallaze), Mr. N. Grose (Roche), "Captains" J. Pedlar, J. Rowse, Walter Higman, J. Jane, C. Harris (Treviscoe), T. Kent, H. Pinch, F. A. Dyer, T. Leigh, Mr. Percy Dyer (St. Austell), Messrs. T. H. Sowell, D. Warne, E. H. Richards, P. Hawke, V. Pond, J. Truscott and F. Morcom (employees of the English China Clays, Ltd.). There was a beautiful artificial wreath from the employees at Wheal Hope. The bearers were Messrs. J. Tonkin, W. Kestle, Joseph Higman, J. James, G. Gerry, and R. E. Collins.

Ball Clays v. China Clays

The development of the Devonshire ball clays is proceeding rapidly. The question exercising the minds of producers of China Clay for pottery purposes, says a prominent ball clay producer, is whether cheap Devon ball clays will displace the cheaper qualities of Cornish clays used as potting clays. It is all a question of relative values and constituent ceramic qualities. The mixing of materials for potting is now a fine art, and potters who have to produce cheap ware have to find cheap materials for mixing together for such product. It is understood that a larger portion of Devon ball clays can be used if scientifically blended with other materials. If, however, the commoner qualities of Cornish potting China Clays are priced relatively with other materials, there is no reason why Cornish potting China Clays should be displaced. The crucial point is the price charged for the clay. Cheapness has always made Cornish clays attractive to buyers, but when this disappears manufacturers immediately look out for some kind of substitute. If the prices of Cornish clays can be kept within limits, as at present, there seems to be no doubt that the output will be enormously increased, and a much greater consumption fostered.

Ball clays are becoming increasingly important to the American ceramic industry, and are receiving much more attention than ever. Ball clays are sold direct from the mines without much preparation other than air-drying, which may occur under ordinarily favourable climatic circumstances. There is now a demand made by the American importer for ball clay guarantees as to moisture. The average water content of the ball clay is from 15 per cent. to 20 per cent. A variation within limits is expected and tolerated, but excessive moisture makes against repeat orders. The climate of Devon renders rigid guarantees impossible, but a high percentage of water is not justifiable. Some prominent Americans are under the delusion that the English producer regards his ball clays as indispensable to America, and is not always fastidious in the qualities shipped. This is an exaggerated idea, English producers being too well aware of the value of the American markets to risk their loss by varying the quality. This brings up the question of the substitution of domestic clays for English clays. Innumerable experiments have been carried out in America on the clays that are produced there. A certain amount of success has been claimed, and in some cases they have ousted English clays. It is generally admitted, however, that, taken all round, they are not as good as the imported product. Formulæ have been worked out with English clays as a basis, and the introduction of a new material would involve a new "mix" in regard to the ingredients of the bodies, which few potters are disposed to risk with such proved and unrivalled qualities that the English china and ball clays possess. Americans rely also upon regular deliveries from England, whereas the supplies of the domestic clays are intermittent.

North Cornwall War Memorial

St. Breward, the China Clay village in North Cornwall, in providing a War Memorial for those who paid the supreme sacrifice, has also combined to cater for those who returned. The memorial takes the form of a fine room added to the already existing institute, the erection and conversion costing a sum of £286, without the furnishings. The whole combines to make a very attractive building of three rooms. The trustees are Messrs. J. H. Curnow (chairman), A. Wilton (secretary), W. W. Harper (assistant secretary), H. May, Z. Spare, J. Wallis, W. Nankivell, H. Tremain, C. Masters, J. Best, A. Hawken, S. Hawken, J. Winn and J. Chapman.

Last month the Lord-Lieutenant, Mr. J. C. Williams, performed the opening ceremony, and unveiled a tablet in the new room in the presence of a large number of people from the parish. The tablet bears the following inscription: "St. Breward War Memorial. This hall is dedicated to the memory of those who fell and also those who served in the Great War—1914–1918."

The Chairman of the Trustees, in presenting the Lord-Lieutenant with a silver key as a memento, said that occasion was particularly interesting to him, as he had the privilege of presenting Lady Onslow with a key at the opening of the old Institute some years ago. Out of the £286 necessary to build and equip the room, £87 had been raised by public subscription, leaving a balance of £199 to be raised. He hoped the young men of St. Breward and all who would use the rooms, would do so not only for recreation purposes, but also from an educational standpoint.

The Lord-Lieutenant said that a memorial in that form did more to bring back memories of those lost to them than any wayside cross. They should remember that the use of the building was entirely dependent on the management, and if they were determined, as the men who served were determined, to sacrifice themselves for one another, they would be more likely to keep them in their recollection. It was the spirit of what those men did that they wished to preserve.

A public tea followed. Mr. Walter Sessions, joint managing director of English China Clays, Ltd., responding for local industries, said that agriculture was their greatest industry, though the stone industry was also an important factor. In the China Clay trade they were not succeeding so well as they hoped to do, though in quantities they were sending out even more than they had done for some time. They were up against the world's price cut as well as the price cut among themselves. In every country with the exception of Little Holland, they were up against import tariffs.

In proposing "Public Bodies," Mr. Sessions declared that the roads in Cornwall were the worst he had ever had to motor over in his experience in many countries, with, perhaps, the exception of Belgium just after the war.

China Clay Candidates for Cornwall County Council

There were few contests for seats on the County Council in Cornwall, but two of them took place in divisions closely associated with the China Clay industry—St. Columb, including Fraddon and St. Enoder, and Grampound, including St. Stephen's and St. Mewan. In both divisions the old members did not seek re-election, Mr. R. R. Trebilcock retiring from St. Columb, and Mr. Sam Jacobs, a well-known China Clay worker in the employ of English China Clays, Ltd., retiring from Grampound.

Captain Mark Richards, residing on the borders of the division at St. Dennis, but having China Clay interests in St. Columb division—a prominent member of the St. Austell Rural District Council and Guardians and formerly chairman of the latter—had a strong opponent in Mr. C. H. Hawke, but succeeded in winning by 59 votes.

In the Grampound division, Mr. W. L. P. Croggan, a tanner of Grampound, and a well-known public man and member of the St. Austell Rural Council and vice-chairman of the St. Austell Guardians, received the strong support of Mr. Sam Jacobs, who was opposed by Mr. Groggan when he previously won the seat. Mr. Croggan's opponent was Mr. R. J. Varcoe, a prominent China Clay producer, residing on the borders of the division at Tregarden, Truro Road, St. Austell, who sought to represent China Clay interests as managing director of Goonvean China Clay Co., Ltd., and St. Dennis and Parkandillack China Clay Co., Ltd.

In his election address Mr. Varcoe stated: "I have consented to be nominated as a candidate for the vacancy on the County Council in your district as I have large interests in the division and am indirectly a very large ratepayer. In a large portion of the division about three-quarters of the rates are

paid by the China Clay industry. In the St. Stephen's area alone the total half-year's rates to March 31 next are about £10,600, and of this amount the Clay companies are paying about £7,800, and I think the St. Mewan parish would show a similar proportion. Therefore, many of us in the China Clay industry feel very strongly that someone interested in the industry should represent it and the district on the County Council. Thus, as the important China Clay industry is not represented, I feel that I can reasonably ask for your vote and your support."

The interest taken by the electors in the election was not keen, only 1,121 out of a total electorate of 3,936 going to the poll. Mr. Varcoe was defeated by a majority of 583 votes, he securing 269 votes against Mr. Croggan's 852. Mr. Varcoe was handicapped by the fact that he had not engaged in public work to the extent Mr. Croggan had done, and also because the latter had previously contested the seat.

At the St. Austell Guardians and Rural Council meetings, the two successful candidates were congratulated on their success.

"*Pinholes*": *Causes and Remedies*

Some Due to Faulty Clay Blunging

In the course of a paper read at a meeting of the Ceramic Society at Stoke-on-Trent, Mr. Harold J. Plant dealt with the occurrence, cause and cure of pinholes in ceramic manufacture. Those arising out of the preparation of the clay used in the body of the ware, to which Mr. Plant referred amongst others, should prove interesting to our readers.

It was in the sliphouse, he said, that most of the potters' trouble as regards body pinholes had its origin. Clay must be blunged properly. Sufficient material should be in the blunger to cover the whole of the knives, the object of this being to rid the clay of any air bubbles rather than to encourage them. The blunging should be carried on until the whole of the material had been reduced to a creamy consistency, free from lumps of any sort other than the small amount of coarse matter that would be contained in the ball clay, if this material entered into the composition of the body.

A manufacturer had suggested as a cause that slip-makers, in an endeavour to increase their putput and thus rushing the blunger, tried to make the sifters do the work that the blunger should do, and this most assuredly led to blibbing clay and slip, to say nothing of other faults that might develop from the same cause. Possibly manufacturers might have noticed how their losses increased as soon as extra pressure of work meant a general speeding up, and some of this loss undoubtedly commenced in the sliphouse. After the slip had been blunged and sifted it was desirable to see that the pump was in perfect running order, so that slip only, and not slip mixed with air, was pumped into the press. Press cloths also were sometimes responsible for pinholes. The preparation used for preserving these cloths often helped to spoil an otherwise good mixture. Mr. Plant believed that the new green cloths, with which most of the Staffordshire potters were familiar, were a distinct advance on the older ones.

Proper Clay Storage

It was obvious also that the proper storage of clay before pugging was essential if the best results were to be obtained. The atmosphere should not be too dry, and the place should be as free from draughts as possible. The clay should be mawed as it was removed from the clay press, and covered with sheets kept in a damp condition until required.

The pug had been found to be a prime cause of pinholes in a china body. Good pugging was absolutely essential if loss through pinholes was to be avoided. No attempt should be made to pug clay that was too soft from the press. Watering the pug must be absolutely forbidden. Soft and hard clay passed into the pug would never mix properly, the reason being that soft clay tended to stick to the knives and barrel of the pug, rendering it impossible for the clay to become properly compressed so as to eliminate air bubbles. It had been found in practice that one knife too many or one knife too few had been the cause of faulty clay, and one could readily believe that if the angle of the knives was not correct it would be impossible to get that solid result that was so necessary in a clay body.

Having produced clay and slip under the most favourable conditions, what now had to be done was to safeguard their use so as to produce ware free from pinholes. Slip for casting should not be used straight from the sliphouse, but should be stored as long as possible in the shop in which it was to be used, so as to avoid a too great variation between the temperature of the slip and the temperature of the mould. Great benefit had been derived from dabbing the moulds (before pouring in the slip) with slip that had been previously stored in the stove itself. The moulds should not be used hot from the stove, but should be allowed to cool somewhat. There was no doubt that the same precaution with regard to hot moulds should be taken in the case of pressed or jollied ware. The elimination of pinholes in flat ware and saucers had been brought about successfully in some cases by the installation of a fan, thus making possible the towing and dry fettling of the ware, instead of the more usual sponging. This process, of course, was common in earthenware, but not so common in china. There was, however, not the slightest doubt that it proved to be of the greatest help, as it was very often a complete cure for pinholes in flat ware.

Avoiding Air Pockets

In the case of cast ware made from alkaline slip, in addition to some of the causes previously mentioned, the addition of dry scraps to the mixing was likely to give rise to the fault, as the air, entering the pores of the clay, had little opportunity for escape, owing to the slimy condition the slip attained when alkalies were introduced. If moulds were very wet or very dry the same faults arose. It was desirable, in the case of very dry moulds, to sponge the face with clean water before pouring in the slip. Pinholes in this case were probably caused by the displacement of air in the pores of the moulds, for, as the moisture in the slip was absorbed by the moulds, some of this air entered the mixture. If moulds were filled too rapidly, pinholes were encouraged; also if the moulds were filled from the tap when the slip was under too great a pressure, or if the slip when kept in a state of agitation was agitated too rapidly so as to develop air bubbles instead of causing them to escape. Needless to say, all slip should be sieved before being passed out into the moulds. Local pinholes might be caused by the use of excess water by the potter when working the clay—for instance, when making the lip of an ewer, or even when fettling a handle, if too much water was used there was at once a predisposition to pinholing.

Summarising his conclusions, Mr. Plant pointed out that pinholes might be caused in numerous ways, such as by: (*a*) The imperfect preparation of the body materials; (*b*) imperfect blunging; (*c*) insufficient ageing; (*d*) a faulty pump pumping air instead of clay; (*e*) bad pugging; (*f*) deleterious press cloths; (*g*) dust on the moulds; (*h*) perished moulds; (*i*) too much water used by the potter; (*j*) cast moulds being too wet, too dry, or too hot; (*k*) bad firing; and (*l*) faulty glaze mixture. Any one of these causes might give rise to pinholes, and very often the trouble could be traced to two or more in combination.

Tragedy at St. Stephen

A sensation was caused at the Cornish village of St. Stephen, near St. Austell, on March 2, by a double tragedy, in which a girl was alleged to have been murdered by her sweetheart, who afterwards committed suicide. The girl, Sidonia Taylor (20), lived with her parents in the village, and had been keeping company with a China Clay worker, Herbert Sandercock (40), for three or four years. A member of the teaching staff of the local school was about to leave the premises on March 2 when he noticed the man Sandercock enter the main schoolroom from one of the other classrooms. Mr. Carwardine noticed the man was doing something to his throat, and had a razor in his hand. On seeing Mr. Carwardine the man retired into the classroom, and later he was discovered dead across the prostrate body of Miss Taylor, who was also dead with a severe gash in the throat. The police were called, and on the man's clothing were found two letters. One was addressed to his father, who lives at Bugle, and the other to his brother, in both of which Sandercock is alleged to have stated what he would do.

Shipping and Export News of the Month

We give below the latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—February, 1925

Arrived	Name	Sailed	Destination
Feb. 1, ss.	*Whinhill*	Feb. 6,	Liverpool
Feb. 1, s.s.	*William Ashburner*	Feb. 4,	Rochester
Feb. 2, s.s.	*Pickmere*	Feb. 6,	Runcorn
Feb. 2, s.s.	*Elise*	Feb. 12,	Charlestown
Feb. 2, s.s.	*Rose*	Feb. 4,	Charlestown
Feb. 3, s.s.	*Procris*	Feb. 5,	Hamburg
Feb. 3, s.s.	*Philotis*	Feb. 7,	Hamburg
Feb. 4, s.s.	*Gouwestroom*	Feb. 10,	Amsterdam
Feb. 4, s.s.	*Sutton*	Feb. 9,	Ridham
Feb. 4, s.s.	*Cornish Trader*	Feb. 9,	Rotterdam
Feb. 4, m.v.	*Helgoland*	Feb. 10,	Sarpsborg
Feb. 5, s.s.	*Treleigh*	Feb. 6,	Charlestown
Feb. 6, s.s.	*Dragoon*	Feb. 10,	Weston Point
Feb. 6, s.s.	*Hartfell*	Feb. 12,	Antwerp
Feb. 7, m.v.	*Isabel*	Feb. 16,	Truro
Feb. 7, m.v.	*N E Schmidt*	Feb. 16,	Copenhagen
Feb. 7, s.s.	*Shoreham*	Feb. 11,	Preston
Feb. 8, s.s.	*Confidence*	Feb. 20,	Helsingborg
Feb. 9, s.s.	*Vera Kathleen*	Feb. 17,	Portland Me
Feb. 11, s.s.	*Pylades*	Feb. 16,	Bo'ness
Feb. 12, s.s.	*Broadgreen*	Feb. 17,	Bilbao
Feb. 12, s.s.	*Overton*	Feb. 16,	Larne
Feb. 12, m.v.	*Drogden*	Feb. 22,	La Pallice
Feb. 12, s.s.	*Fairland*	Feb. 17,	Liverpool
Feb. 13, s.s.	*Brier Rose*	Feb. 14,	Newlyn
Feb. 13, s.s.	*Katherine*	Feb. 16,	Plymouth
Feb. 13, s.s.	*Achroite*	Feb. 17,	Weston Point
Feb. 15, s.s.	*Rival*	Feb. 20,	Antwerp
Feb. 16, s.s.	*Wearbridge*	Feb. 21,	Portland Me
Feb. 16, s.s.	*Lady Agnes*	Feb. 19,	Goole
Feb. 16, s.s.	*Essonite*	Feb. 18,	Glasgow
Feb. 16, s.s.	*Autinea*	*	Genoa
Feb. 17, s.s.	*Penryn*	Feb. 18,	Bristol
Feb. 17, s.s.	*Urpeth*	Feb. 21,	Brussels
Feb. 17, s.s.	*Mary Ann*	Feb. 24,	Ardrossan
Feb. 17, s.s.	*Afon Towy*	Feb. 19,	Llanelly
Feb. 17, s.s.	*Falmouth Castle*	Feb. 19,	Runcorn
Feb. 17, s.s.	*Athena*	Feb. 18,	Rochester
Feb. 17, s.s.	*Englishman*	Feb. 22,	Mevagissey
Feb. 18, s.s.	*Farfield*	Feb. 21,	Preston
Feb. 19, s.s.	*Mersey*	Feb. 21,	Hull
Feb. 19, s.s.	*Ferndene*	Feb. 21,	Ridham
Feb. 19, s.s.	*Gertie*	Feb. 20,	Barrow
Feb. 19, s.s.	*Monksville*	Feb. 24,	Preston
Feb. 19, s.s.	*Isabeletta*	Feb. 23,	Runcorn
Feb. 19, s.s.	*Trader*	Feb. 23,	Newcastle
Feb. 19, s.s.	*Horsham*	Feb. 26,	Rochester
Feb. 19, s.s.	*Gouwestroom*	Feb. 25,	Amsterdam
Feb. 20, s.s.	*Isabella*	Feb. 26,	Antwerp
Feb. 20, m.v.	*Petite Janine*	Feb. 27,	Dunkirk
Feb. 20, m.v.	*Lydia Cardell*	Mar. 6,	Rouen
Feb. 20, m.v.	*Henrietta*	Feb. 21,	Pentewan
Feb. 21, m.v.	*Louise Ernest*	Feb. 23,	Par
Feb. 21, s.s.	*Aarsten*	Feb. 26,	Leith
Feb. 22, s.s.	*Whinhill*	Feb. 27,	Liverpool
Feb. 22, s.s.	*Barflo*	Feb. 27,	Brussels
Feb. 22, s.s.	*Amy*	Feb. 23,	Par
Feb. 23, s.s.	*Cervantes*	Feb. 26,	Genoa
Feb. 25, s.s.	*Scotia*	Mar. 2,	Philadelphia
Feb. 25, s.s.	*Tofuku Maru*	Mar. 7,	Philadelphia
Feb. 27, m.s.	*Schelde*	Mar. 3,	Aberdeen
Feb. 27, m.v.	*Lynetten*	Mar. 4,	Rouen
Feb. 28, m.v.	*Catherine*	*	Drammen
Feb. 28, s.s.	*Ualan*	Mar. 3,	Antwerp
Feb. 28, s.s.	*Via*	*	

* Signifies " In Port."

Charlestown Shipping—February, 1925

Arrivals

Date.	Vessel.	From
January 28	*Pickmere*	Barry
January 31	*Isabella*	Falmouth
February 3	*Rose*	Salcombe
February 5	*Alert*	Truro
February 5	*Guardian*	Teignmouth
February 6	*Ribbledale*	Plymouth
February 6	*Snow Queen*	Plymouth
February 6	*Treleigh*	Fowey
February 7	*Christiana*	Poole
February 9	*Maagen*	Lisbon
February 12	*Elise*	Reone
February 14	*Heatherlea*	Looe
February 18	*Millocrat*	Penryn
February 19	*Charbomire*	Plymouth
February 20	*Vilborde Maritime*	Poole
February 21	*Abercraig*	Cardiff
February 28	*James Tennant*	Kingsbridge

Sailings

Date	Vessel.	Destination.
February 3	*Isabella*	London
February 7	*Guardian*	Rochester
February 7	*Ribbledale*	London
February 9	*Rose*	London
February 9	*Snow Queen*	Manchester
February 9	*Treleigh*	Preston
February 9	*Noah*	Granton
February 11	*Alert*	Western Point
February 11	*Christiana*	Fleetwood
February 14	*Heatherlea*	Rochester
February 20	*Millocrat*	Western Point
February 20	*Charcomire*	Brussels
February 22	*Vilborde Maritime*	Brussels
February 28	*Elise*	Leith

Par Harbour Shipping—February, 1925

Arrivals

Date.	Vessel.	From
February 2, s.v.	*Shoal Fisher*	Falmouth
February 2, s.v.	*Duchess*	Mevagissey
February 3, m.v.	*Anna*	Salcombe
February 4, s.v.	*Lady Agnes*	Port Leven
February 12, s.s.	*Magrix*	Truro
February 17, s.s.	*Robrix*	Teignmouth
February 17, m.s.	*Press On*	Plymouth
February 17, m.v.	*Hope*	Fowey
February 18,	*Gwendoline*	Plymouth
February 18, s.v.	*Guiding Star*	Falmouth
February 19, s.s.	*Glenrose*	Kingsbridge
February 19, s.v.	*Mary Edwards*	Plymouth
February 21, s.s.	*Whinstone*	Cardiff
February 22, s.v.	*Kate*	Penryn
February 22, s.v.	*Triumph*	Plymouth
February 22, m.v.	*Donald and Doris*	Port Talbot
February 23, s.v.	*Louise Ernest*	Plymouth
February 23, s.v.	*Amy*	Cardiff
February 25, s.s.	*Multistone*	Haarlem
February 27, s.v.	*Englishman*	Mevagissey
February 27, s.s.	*Arman Dumon*	Falmouth
February 28, s.s.	*Bruxelles Maritime*	Penzance

Sailings

Date.	Vessel.	Destination.
February 1, s.v.	*Kate*	Plymouth
February 6, s.v.	*Rosina*	Erith
February 7, s.v.	*St. Michiel*	Nantes
February 7, m.v.	*St. Austell*	Poole
February 7, s.v.	*Shoal Fisher*	Newcastle
February 7, m.v.	*Anna*	Antwerp
February 13, s.s.	*Magrix*	Teignmouth
February 14, s.v.	*Mary Barrow*	Rochester
February 14, s.v.	*Lady Agnes*	London
February 17, s.s.	*Robrix*	Hull
February 19, s.v.	*Gwendoline*	Plymouth
February 20, s.s.	*Glenrose*	Greenhithe
February 22, s.v.	*Mary Edwards*	Plymouth
February 25, s.s.	*Whinstone*	Terneuzen
February 27, s.v.	*Guiding Star*	Runcorn
February 28, s.v.	*Kate*	Plymouth
February 28, m.v.	*Donald and Doris*	Penarth
February 28, s.v.	*Louise Ernest*	London
February 28, s.s.	*Multistone*	Newcastle
February 28, s.s.	*Arman Dumon*	Rouen

Par Harbour Tide Table, March, 1925

(Greenwich Mean Time Throughout.)

Day of Week	Day of Month.	Morning.	Afternoon.	Height.
Saturday	21	2.16	2.56	11.4
Sunday	22	3.31	3.59	12.4
Monday	23	4.26	4.52	13.2
Tuesday	24	5.15	6.36	13.7
Wednesday	25	5.58	6.17	13.9
Thursday	26	6.37	6.54	13.10
Friday	27	7.11	7.27	13.6
Saturday	28	7.43	8.0	12.11
Sunday	29	8.17	8.32	12.1
Monday	30	8.47	9.5	11.3
Tuesday	31	9.25	9.45	10.4

E. CLEMENS, Harbour Master.

February China Clay Trade

WITH three working days shorter and one more Sunday than in January, the total volume of trade in February was about 4,000 tons down on the month, but the ratio of trade to working days was well above the January aggregate. The deliveries of ball clay were small. China stone showed an increase of about 1,000 tons, but China Clay was over 7,000 tons down.

The detailed figures, and comparisons with immediately preceding months are appended :

Port.	China Clay. Tons. 1925	1924	China Stone. Tons. 1925	1924	Ball Clay. Tons. 1925	1924	Total. Tons. 1925	1924
Fowey	53,880	36,563	3,091	1,560	614	1,118	57,585	39,241
Par	1,741	3,224	321	—	—	—	2,062	3,324
Charlestown	4,072	3,000	—	—	—	—	4,072	3,000
Plymouth	1,276	1,856	24	15	—	—	1,300	1,871
Penzance	500	303	—	—	—	—	500	303
Truro	—	238	—	—	—	—	—	238
Falmouth	—	74	—	—	—	—	—	74
By Rail	5,394	6,886	—	—	—	—	5,394	6,886
Totals	66,863	52,244	3,436	1,575	614	1,118	70,913	54,937
January	74,490	56,686	2,506	3,978	3,050	1,567	81,046	62,231
December	—	64,860	—	2,613	—	3,083	—	70,926
November	—	71,546	—	3,912	—	1,238	—	76,696
October	—	80,197	—	3,693	—	2,821	—	86,711
September	—	74,157	—	4,368	—	3,342	—	81,868

China Clay Exports

RETURN showing the exports of China Clay, the produce of the United Kingdom, from the United Kingdom, to each country of destination, as registered during the month ended February 28, 1925 :—

COUNTRY OF DESTINATION.	QUANTITY tons.	VALUE. £
Sweden	735	1,149
Norway	1,569	1,875
Denmark (including Faröe Islands)	707	1,728
Germany	2,275	5,960
Netherlands	2,460	5,172
Java	102	391
Belgium	6,468	11,855
France	2,890	5,388
Portugal	13	52
Spain	792	1,807
Italy (including Fiume)	5,078	10,818
Siam	2	10
China (exclusive of Hong Kong, Macao and leased territories)	5	19
United States of America	41,849	85,900
Cuba	5	52
Mexico	130	520
Brazil	12	48
Argentine Republic	76	496
BRITISH POSSESSIONS.		
Irish Free State	5	20
Natal	—	1
Transvaal	1	19
Madras	10	40
Bengal, Assam, Bihar, and Orissa	454	1,816
British India, *via* other ports	1,887	7,424
Federated Malay States	1	5
Australia	8	32
Canada	101	121
Total Foreign Countries and British Possessions	67,635	£142,718

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908, provides that every Mortgage or Charge, as described there, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

PENRICE CHINA CLAY CO., LTD., Hayle. Registered February 17, £3,000 debs. (filed under sec. 93 (3) of the Companies (Consolidation) Act, 1908), present issue £2,000 ; general charge. *——. July 2, 1924.

London Gazette

Company Winding Up Voluntarily

DORSET ART POTTERY, LTD. M. E. J. Pearce, incorporated accountant, of 102, High Street, Poole, appointed liquidator, February 11.

Quality of American China Clays

THAT American clays compare favourably with foreign clays as fillers in making paper is the conclusion drawn from an investigation of clays for this purpose made at the U.S.A. Bureau of Standards. The amount of clay retained in the paper, and in general the quality of the paper, were found to be the same for both American and foreign clays. A slight advantage for the foreign clays was shown by the colour and grit tests, but the Bureau does not consider it sufficient to justify the consideration of only these properties in selecting clays.

Most of the tests were made in the experimental paper mill at the Bureau of Standards, although duplicate tests of part of the work were made in a commercial mill. Eight representative clays were used, and the study included a comparison of the amount of clay retained in the finished paper, the quality of the paper produced and those properties of the clay, such as grit, that might affect the paper-manufacturing process. Good agreement was found between the results in the experimental mill and those in the commercial mill.

Clays have long been used as fillers in making paper, their purpose being to increase its opaqueness and to improve the printing quality of the surface. Paper makers in general have favoured clays from foreign sources, believing that American clays produced inferior paper. The present investigation was made with a view to ascertaining whether or not this belief is true.

China Clay Vessel's Adventure

THE *Port Augusta*, westward bound from Fowey, arrived at Philadelphia 18 days late on February 1, after an exciting voyage, in which she was severely damaged.

Her steering gear was smashed and the boatswain, Dennis Wholey, crushed and seriously injured. For five days and nights Captain T. Kippins kept watch without leaving the bridge. Half-way across, the mate, G. T. C. Harris, was thrown across the bridge and sprained his ankle. The cargo of 6,000 tons of China Clay shifted and caused the ship to list. George Richardson and Seaman Charles Keating were also injured and all the crew suffered from minor hurts. Forty miles off Delaware coal gave out and rations had been reduced to emergency supply of beef severely rationed owing to the fact that all normal supplies had been lost. All available woodwork had been taken for fuel when the vessel arrived. The vessel narrowly missed total wreckage on several occasions.

China Clay Imports for February

A RETURN showing the registered imports of China Clay (including China Stone) into Great Britain and Northern Ireland from the several countries of consignment during the month of February, 1925 :—United States of America, 27 tons, valued at £110.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., 8, Bouverie Street, London, E.C.4. All communications relating to Advertisements, Subscriptions and other business should be sent to the Manager, "The China Clay Trade Review," at the same address. Telegrams—"Allangas, Fleet, London." Telephone—City 9852 (6 lines).

"Clay-dyeing" Process

In our last issue a report was published, received from a source which led us to suppose it was authentic, concerning a new "clay-dyeing" process which, it was stated, involved in the dyeing industry, especially in relation to artificial silk, a considerable use of China Clay. We now find the assumption that the process had anything to do with China Clay to have been entirely without foundation and take the first opportunity of stating the actual facts. The dyeing process referred is one used by Robert Clay, Ltd., of Cheadle, Cheshire. The title "Clay-dyeing" is simply taken from the name of the firm, and we have the authority of Mr. Vernon Clay, director of Robert Clay, Ltd., for stating that "certainly no China Clay is used in the process." We regret having been misled into publishing the report.

Mechanical China Clay Production

There was a time, not many years ago, even up to the outbreak of war in 1914, when many China Clay producers looked askance at modern machinery for the purposes of China Clay production. In 1914 the number of works employing hydraulic hoses for the breaking down of the clay from the stopes of the pit could be counted on the fingers of one hand. Then men known as "breakers" were employed on a large scale, and they broke the clay by hand with picks in the track of the clay streams. Now there are few works where this primitive method survives, for powerful hydraulic hose is used and operated by one man, where formerly several men were required for the same operation. In deep pits the natural pressure of water from above is sufficient to provide the force required to break up the crude clay, but in other cases compressed air and electrical power are brought into service. This general adoption of hydraulic hoses is an indication of the readiness with which China Clay producers nowadays are prepared to make innovations, when the innovations are proved to be economical and progressive.

The force of circumstances such as the greatly increased cost of manual labour and the very high cost of coal has given the China Clay producers cause to think of how best they can lessen production costs, and they have been turning more and more to machinery and mechanical devices.

New Machinery Age

Just as no modern China Clay works is now developed without the China Clay being piped in its liquid state from the works to the drying kiln, and without the kiln being placed wherever possible alongside the railway, so no up-to-date China Clay producer expects to make his works a commercial success without the most modern machinery and equipment. This is seen in the transformation of many old works from steam to gas and in many cases from gas to electricity. There was a time when China Clay producers looked upon electricity as a new-fangled idea that could never be economically developed on commercial lines in China Clay works. Now all is changed. So successful have the pioneers of electricity in the works for power purposes in winding and pumping proved the innovation by actual results that other works have not been slow to recognise it. Consequently, during the last 10 years more electrical power plant and machinery have been introduced into the China Clay works than during the whole of its previous history.

Central Electric Power Station Wanted

Unfortunately in Cornwall, as in many other industrial centres, electrical companies have not been enterprising enough to encourage the use of electricity by its transmission from big central power stations. The result has been that China Clay works changing from steam or gas to electricity have perforce to erect their own generating stations. Up to now suction gas plants have been in favour for driving the dynamos, but modern tendencies point to both coal and gas being superseded by oil engines. Undoubtedly, if a great central power station were erected in the heart of Cornwall from which electricity could be transmitted cheaply to the China Clay works more electrical machinery would be used, because it is not all works that have the capital, or, if they have the capital, have not the inclination to instal their own power plant. Such small public power stations as are at present in existence at St. Austell and Hayle are unfortunately not able to provide the requisite power at a price per unit to justify works drawing their current from these stations. As is pointed out elsewhere in this issue, a movement is on foot for the establishment of a power station in the vicinity of St. Austell, but whether this scheme will mature events will prove. Whatever happens, there is no doubt that so far as the China Clay industry is concerned, it is the age of electricity, and in one way or another the gradual supersession of existing machinery for electrical is only a matter of time, in view of the abundant evidence that has been forthcoming in recent years as to its importance as a factor in the cheaper production of China Clay. Though Cornwall is a wet county it boasts of no great rivers from which power could be drawn on a large scale, but there are many streams that could be utilised to a greater extent than they are at present for the generating of power for individual works.

Countries up to Pre-war

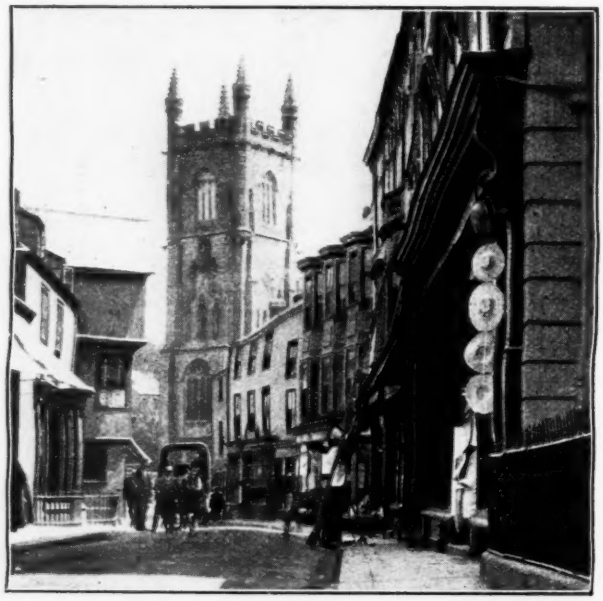
Belgium, Italy, and Spain are the only European countries that have reached the pre-war level in their imports of China Clay from us, the growth of the markets of Italy and Spain being particularly noteworthy and encouraging, as they indicate an extension in the use of China Clay in those countries. The small States carved out of Russia are showing signs of activity, particularly Finland, with a volume of 10,000 tons per annum. In the smaller foreign countries like Switzerland, Mexico, and Argentina, China Clay is being used in quantities which indicate that here are markets that are capable of expansion. Direct exports to Canada do not reveal much expansion, but this may be accounted for by her drawing supplies through American ports. India is at last showing some signs of approach to her pre-war volume, last year taking the largest quantity since 1920. The most encouraging development in British possessions is in South Africa, having last year for the first time taken the substantial quantity of nearly 4,000 tons, the bulk of which went to Natal. The new industry of paper-making being developed in this colony should prove a welcome new outlet for China Clay in the future.

Historic St. Austell

Origin of Familiar Places in China Clay District

A FASCINATING lecture was given at St. Austell recently by Mr. H. S. Hancock, who, besides having been closely associated with the China Clay industry for many years, is the recognised authority on the parish of St. Austell, ancient and modern. His references to localities familiar to China Clay landowners, producers, merchants, and buyers cannot fail to prove interesting to many of our readers.

Mr. Hancock said that the civil parish of St. Austell was covered originally by the ancient manors of Treverbyn, Tewington, and Trenance, with the whole of the rural and urban areas. The civil parish extended from Pentewan to Par Hall and Harbour, Tregrehan, Bugle, and the clay district



MAIN STREET OF CLAYOPOLIS 20 YEARS AGO SHOWING FRONTAGE OF THE TREMAYNE'S FORMER TOWN HOUSE ON LEFT.

below Bugle, down to the golf course. This parish was one-fifth in size of the civil parishes of Cornwall, though it was now divided into two civil parishes. They had all heard the joke of "Tregorrick Harbour," but there was more in that than they thought. In olden days, boats came up to St. Austell where Pond-dhu Bridge was now, and judging from the level from that bridge to Pentewan and Tregorrick, and the depth of sand that had been found in the valley, it was very likely that Tregorrick was once the discharging port for boats. Going south to Tregrehan Estate there was a very interesting old manor with the date over the door, 1645. Towan was originally the house of the Sawles of Towan, and at the farm-house there was an ancient doorway and window of the old Manor House. The family had extended the borders of the land, and now resided at Penrice, though formerly Penrice was not in existence. There was also a Holy Well at Towan, which was in an excellent state of preservation. An old nunnery near by at Molingey was preserved in an original building, though the stones had been turned with the plain part outside by an economical steward of the estate.

Pentewan and Charlestown

Mr. Hancock referred to a John Polrudden, of Pentewan, the former owner of the Polrudden Quarry, from which the famous Pentewan stone came. A Polrudden lived at Pentewan now. The original house of John Polrudden was destroyed, but they had in the church, forming the pedestal part of the table inside the church, what was formerly a piece of the jamb of John Polrudden's house, which was burnt down in the reign of Henry VII. Pentewan had been a port for about 100 years, but the sand from the clay works had made against it, though it might become a port again. At Trenarren Blackhead, between Pentewan and Porthpean, was one of the oldest British castles in the county, and what most people would take for a dyke on the headland was really part of an ancient earthwork. Trenarren was a great fishing village at one time, distributing fish all over the district. The view from the Blackhead was about the finest in Cornwall, Castle Gotha, between Porthpean and Trenarren, was another antiquity. Charlestown was originally called Port-mear or Polmear. Charlestown was not a Cornish name, but was so named in honour of a member of the Rashleigh family. Most of the Cornish names meant something, and he would like to see them restored, among them Polmear. On the Porthpean Road was a stone post which was an ancient monument of some sort with its own legends, and was a somewhat similar antiquity to the "Piper and Merry Maidens" further west.

Treverbyn and Bugle

In former days all the low-lying lands in the vicinity of Par were under the sea, which came up to the Britannia Inn. Boscundle, on the Tregrehan Estate, was one of the most ancient places that remained. Boscundle was formerly an ancient holding of the Truebody family, that intermarried with the Carlyons, and which had dwindled down to one representative. Garker Moor, which was part of the ancient Manor of Treverbyn, and Tewington, were the only two places in the locality recorded in the Domesday Book. Garker Moor had always been noted for its tin, and clay had been discovered under the tin. Trethurgy also was in existence at the time of the Domesday Book. The village of Treverbyn Minor was ancient, and was the village which gave its name to the manor. The Lord of the Manor lived at Knightor. The name of Bugle, in the heart of the China Clay fields, was originally Carnsmellyn.

An ancient monument in the parish was Hensbarrow Beacon. There was also an old stone found in that region some 25 years ago, called the Hensbarrow Stone, which was shaped like the back part of a boat and bore marks that were very ancient. He was of opinion that it was the Sun-stone.

How St. Austell was so Named

At Gover, streaming for tin had been carried on. Trenance was the manor which gave its name to the town. The original Menacuddle Farm was a manor house, which had its own church, chapel, and burial ground. Menacuddle main road was probably in existence before horse roads were ever known. The old Menacuddle Well and 15th century chapel were well worth visiting. Menacuddle Well and grounds were given back to the church by Sir Charles Sawle, after the death of his son. Then there was the Stony Chair in Hick's Wood, which was very ancient and well worth seeing. The old name of the town was "Trenance-Austell." "Saint" was not old Cornish at all, and was prefixed by a jealous head of the parish, so as to be on a level with other parishes that had adopted the "Saint." The Priory was so called because it was formerly part of the manor belonging to the Priors of Tywardreath, so that it was really St. Austell Prior. The Mengu Stone in Fore Street had a history and there were different theories as to its origin, one being that it was the spot on which witches were burnt at the stake. His opinion was that it marked the boundary between the Manors of Tewington, Treverbyn, and Trenance. The Manor House, now occupied by the Co-operative Stores, he thought was formerly a Manor House, and that the parish church was built by the Lords of the Manors that met there, because on the tower they had the arms of some of them. The premises occupied by Mr. Luke in Fore Street were formerly the town house of the Tremayne family. The former town house of the Rashleighs was the White Hart Hotel. In the days of Elizabeth the maps gave only a church at St. Austell, and no town.

Church Tower one of the Finest in England

The Parish Church, contrary to popular belief, was not built of Cornish granite at all, but the outside was Pentewan stone. The oldest part of the church he could find was a piece

under the chancel window, which was the only piece of early Norman work. The pillar on the side of the chapel was old Norman. The fine chapel in the church had been restored regardless of cost, by the Hicks family. It was built in the reign of Edward II. and they could not match it in the County of Cornwall. Whether Bishop Bronscombe's church, consecrated in 1100, was the present chancel or the north chancel they did not know. The main church was supposed to have been built in the reign of Henry VI. The tower was one of the finest in England. Referring to the three fine southern windows, Mr. Hancock said that the masonry had to be restored. They were of plaster, and the pity was that they had not restored them before when the expense would have been less. He was very proud of their fine church, and it was a great duty on the present generation to see that it was kept as it had been made by the thought and labour of others.

Britain's China Clay Resources

A Survey of the Industry in General

WITH the exception of coal, kaolin or China Clay is the most important raw material produced in Great Britain. Practically half the kaolin produced in the world comes from this country.

Kaolin was first discovered in Cornwall in 1755, and exports of China Clay and stone to the Staffordshire potteries began some four years later. Afterwards, beds of China Clay were discovered in North, West and Mid-Cornwall, and on the southern slopes of Dartmoor. Not only does England stand pre-eminent in the production of China Clay, but the fact that the clay areas in Cornwall are near the seaboard, and the biggest markets to which the clay is exported are similarly situated, makes transportation cheap, as it can be done by water. Thus the price of the commodity is kept comparatively low and England has nothing to fear from competition.

The year 1912 was the best the British industry ever experienced. In that year nearly one million tons were produced. After the war there was a boom in 1920 followed by a slump in the following year, as the following figures show. The countries responsible for this decline were Germany and Russia, which in 1912 took over 140,000 tons of kaolin from this country, according to Mr. A. B. Tucker, writing in *Imperial Commerce*.

What Becomes of the British Output

While the Staffordshire potteries look to the Cornish fields for their raw material, they cannot take anything like all the output and a large quantity is exported. In most cases it is desirable to export a manufactured article. An example of an effort in this direction in order to keep the labour in the country of origin is seen in the action of some of the Canadian provinces in regard to pulpwood. The export of this raw material cut on Crown lands is forbidden, the manufacture of the wood into pulp being thus done in Canada instead of in the United States, which is the chief purchaser of this material from Canada. In the case of kaolin, the raw material from its very abundance must be exported to a large extent. This supplying a great portion of the world's needs is the natural consequence of possessing the largest supply.

The deplorable part of this transaction lies not in the mere export of the raw material, which is a sound business proposition, but in the fact that before the War, Germany, which yearly purchased large quantities of our China Clay, used to send to us a considerable amount of china and crockery made of our clay, and dumped into this country at prices much lower than Staffordshire potteries could charge.

World's Production of China Clay

The following figures recently published by the Imperial Resources Bureau show as far as can be shown from available statistics what is the world's production of kaolin, what the British Empire produces, and how much is turned out by foreign countries. The table deals with the years 1919-22 inclusive :—

STATISTICS OF CHINA CLAY PRODUCTION

PRODUCING COUNTRIES.	1919 Tons.	1920 Tons.	1921 Tons.	1922 Tons.
BRITISH EMPIRE—				
United Kingdom ..	463,711	777,511	435,844	666,834
Canada	678	610	111	1,069
Federated Malay States.....	(*a*)	(*a*)	(*a*)	(*a*)
Australia (*b*)	5,300	5,600	4,600	5,500
Total British Empire (*k*)	469,700	783,700	440,600	673,400
FOREIGN COUNTRIES—				
Austria	(*c*)	(*c*)	7,700	(*c*)
Belgium (*a*)	—	1,013	689	2,863
Denmark (*e*)	11,692	17,522	4,018	4,823
France (*b*)	55,600	63,673	(*c*)	(*c*)
Germany :				
Bavaria	126,360	191,359	222,987	(*c*)
Saxony (*g*)	(*c*)	48,017	51,197	(*c*)
Italy.....	18,765	19,011	9,825	7,563
Rumania	—	—	4,500	5,180
Russia	(*c*)	16	(*c*)	(*c*)
Spain	33	935	(*i*) 1,421	(*i*) 11,434
Sweden	4,963	4,667	—	—
Algeria	(*c*)	354	(*c*)	(*c*)
United States (*j*) ..	136,453	239,467	145,291	245,500
Chile.....	640	640	650	(*c*)
Korea.....	978	1,635	(*c*)	(*c*)
Estimated total ..	412,000	420,000	440,000	450,000
World's total	881,700	1,200,000	880,000	1,120,000

(*a*) Production of China Clay was begun in the Federated Malay States in 1920, but information regarding output is not available. (*b*) Approximate production. (*c*) Information not available. (*d*) "Eurite" and kaolin. (*e*) Exports. (*f*) Including kaolinic sand and felspar. (*g*) Crude kaolin and washed kaolin. (*h*) Converted from cubic metres at the rate of 1 cubic metre=2 long tons. (*i*) Including 543 metres and 5,702 cubic metres produced in quarries during 1921 and 1922 respectively. Production from quarries not reported in 1919 and 1920. (*j*) Sales of China Clay and "paper clay." (*k*) Excluding Federated Malay States.

It will be noticed that the estimated totals given of amounts produced by foreign countries differ sometimes widely from the totals obtained by casting up the columns. The totals given are for China Clay only, and do not include paper clay from the United States, and allowance has been made for production in countries where the figures are not available.

Kaolin is the purest form of clay. It is a hydrous aluminium silicate. Its origin may be traced to the alteration of certain aluminous silicates like felspar, scapolite, beryl and topaz, but the largest deposits of China Clay are due to the decomposition of felspar generally in granite, but sometimes in gneiss, etc. The China Clay deposits in Cornwall are granites in which the orthoclase has become kaolinised. Kaolin as dug out of the earth somewhat resembles mortar. The crude material is first sorted, care being taken to remove admixed quantities of quartz, etc., as far as possible. The clay is then stirred, while a stream of water flows upon the mass and carries the lighter portion into channels known as "drags," where after ridding itself of impurities, the fluid runs into another set of channels known as "micas," where a settling of the finer materials takes place.

After a sufficient consistency is obtained, all moisture is expelled from the clay and the resulting material is a soft white substance. This is dried—a process which used formerly to take some months and is now accomplished by modern methods in as many days—and is then cut into blocks for the market.

The Federation of British Industries in their book on Empire Resources sums up the advantages possessed by Cornwall in the production of kaolin as follows :—

(1) The large size and convenient situation of deposits which are close to the surface and extend over wide areas. (2) The great uniformity in composition due to preliminary preparation. (3) The quality and colour of the clay are better than those of kaolin produced anywhere else in the world. (4) The geographical situation of the deposits, to which attention has been drawn above.

Saving Filler Losses in Paper Manufacture

Cutting Waste of China Clay

THIS description of a paper making invention should be of interest to all connected with the China Clay industry, in that it purports to effect great savings on the consumption of China Clay in paper manufacture. The paper industry makes vital demands on China Clay, and its requirements are therefore of very considerable significance.

In the manufacturing of paper there is used, as is well known, large quantities of China Clay and other filling materials. These filling materials, or fillers, give the paper certain properties as for instance, increased weight, and a surface which is more even and more easily glazed and therefore more suitable for writing and printing. The fillers enhance the tone and strength of colour and diminish the transparency of the paper. These fillers have hitherto been added to the paper substance in dry form or in the form of an emulsion in the beaters. Sometimes the filler is boiled with starch or glue. When the filler is added to the beater or the mixer in dry form, the China Clay will often form undissolved lumps, which are only partly fixed on the fibres, and the remainder is lost according to a Finnish paper journal.

It is better to put the filler in the beater in the form of an emulsion—before the sizing—as all the coarser parts, particles of dirt, etc., can be sifted away from the emulsion, but in this process the loss also is rather great. One generally calculates with 60–70 per cent. loss for gypsum, 50–60 per cent. loss for heavy spar, 22–25 per cent. for talc and China Clay, 25–40 per cent. for asbestine. As fillers fetch a high price the lost values are very great, and this of course considerably increases the cost of production of the finished product.

An engineer, Fritjof Olander, and a paper maker, W. Moisio, at Aanekoski Paper Mill, made trials by adding the filler in the form of an emulsion direct on the wire, and they have obtained very good results. The filler which has a certain consistence, is added to the paper when same begins to form on the wire at the first suction box. The place depends upon the amount of water in the stock, on the beating, and on how much filler the paper will contain, and therefore the distributor or filler can be regulated in the longitudinal direction of the wire.

The China Clay dissolver or emulsifier is placed above the beaters and a certain quantity of the China Clay is suspended in a certain amount of water, say 600 litres to 13 kg. of clay. When the China Clay is thoroughly emulsified the composition is conducted through a tap into the first sieve, which consists of a wooden case, divided into two parts by a vertical sieve. In this sieve all the coarser particles, such as grit, impurities, etc., remain. From here the emulsion of filling material runs to a large reservoir which is equipped with an agitator. This reservoir can be made out of wood or concrete, and must be large enough to hold sufficient emulsion for 24 hours' need. From the reservoir the emulsion runs through a copper mouthpiece of the pipe from the reservoir into a second sieve. The mouthpiece can either be regulated for various diameters, or several mouthpieces with different mouths may be used.

Filler Losses

The loss of filler depends upon what time during the formation of the paper it is added. In case this is done too early it causes a great loss, as the filler, partly on account of its own weight, is sucked with the water through the paper. In case the filler is added too late the loss may be nil, but then the filler will stay almost entirely on the surface of the paper. This can be proved by adding, say in the manufacturing of printing paper, China Clay mixed with water and coloured with fuchsine or methyl violet to the solution of the third sieve. One can see with the naked eye that if the apparatus is rightly put in, there are coloured China Clay particles almost in the same proportion per cc. on the upper side of the paper as on the surface facing the wire. The apparatus has so far been tested for adding 2–25 per cent. filler of the weight of the paper, but in case the strength of the paper admits it, larger amounts of filler may be added. The loss of filler is, at a retention 2–10 per cent., about 7–8 per cent.; at greater amounts it is somewhat more.

The process gives the advantage that the loss of filler does not exceed 10 per cent.

The invention is protected by patent in almost all countries with a large paper industry.

Steatite Talc and Kaolin

To the Editor of THE CHEMICAL AGE.

SIR,—Will it be possible for you kindly to put me in touch with any large companies or firms who may require Steatite Talc and Kaolin? I have the above minerals in large quantities here on my farm in Zululand and shall be glad to sell them to any large company or firm who would care to purchase same. I may state that the farm is situated approximately 20 miles from the present railhead. When the new line, at present under construction, to the Zululand cotton fields is completed, by the end of this year, the railway may be brought to within 10 or 12 miles from the property. A large river flows through the farm within 10 yards from the steatite talc and kaolin. Plenty of cheap native labour is obtainable from the large native location which is situated within four miles from the property. Further particulars will gladly be furnished upon applying direct to me.—Yours, etc.,

A. F. WOLHUTER.

P.O. Box 395,
Pietermaritzburg, Natal,
South Africa.
March 12.

China Clay Exports to India

To the Editor of THE CHEMICAL AGE.

SIR,—On page 17 of the *China Clay Trade Review* Section of January 17, 1925, you have given some export figures which we find incomplete, inasmuch as you have not given the figure of exported quantity from Great Britain to India. This we have to bring to your notice as the exports to India are nearly 2,500 tons per month.—Yours, etc.,

C. DOCTOR AND CO.

Railway Pura Post, Ahmedabad.
March 27.

Clay Works Electrification

Suggestion for Central Power Station

A FREQUENTLY occurring question is: "With coal fuel as a basis, would it be cheaper to provide the clay area with electrical power from a central power station than to maintain the present system?" It is not only a case of supplying the China Clay industry with cheap power. The use of coal in large modern stations is much more economical than its use in isolated steam engines, etc. There are several firms using electricity generated by their own plant on their works, including English China Clays, Ltd., H. D. Pochin and Co., Ltd., John Lovering and Co., West Carclaze China Clays, Ltd., the Great Treverbyn China Clay Co., Ltd., the Great Halviggan China Clay Co., Ltd., Parkyn and Peters, the Great Hallaze China Clay Co., Ltd., the Lower Lansalson and Caudledown China Clay Co., Ltd., and North Goonbarrow China Clay Co., Ltd. In some cases the electricity is generated from dynamos driven by gas engines or steam engines, and in other cases by oil engines. The experience of these companies is leading more companies to install electric plant.

Need for Central Power Station

A central electric power station could supply a large district, and it would materially reduce the cost of coal, including transport. When steam plant is used the fires for steam raising are usually left burning all the time, and this in itself entails endless waste. If electric current were available it could be switched on and switched off as required. A small compact motor, occupying only a little space and needing only a very small cheap hut to protect it, could do the work of a 100 h.p. steam engine requiring a fairly large permanent building to house it, with boiler and boiler house in addition for steam raising. Hence the installation of electric motors would mean a huge saving in constructional costs and in man power, there being no coal to handle, no fires to stoke, or ashes to remove. Mobility is also an important factor. Electrical energy, unlike steam, is so easily conveyed to the

point where the power is required. Clay washing is usually carried out chiefly by daylight. There is no reason why the production of clay should depend on the hours of daylight. Electric lighting of pits would enable the washing to be carried on continuously, as is now done where electricity has already been installed. If cheap power were available the cost of production would be considerably lowered.

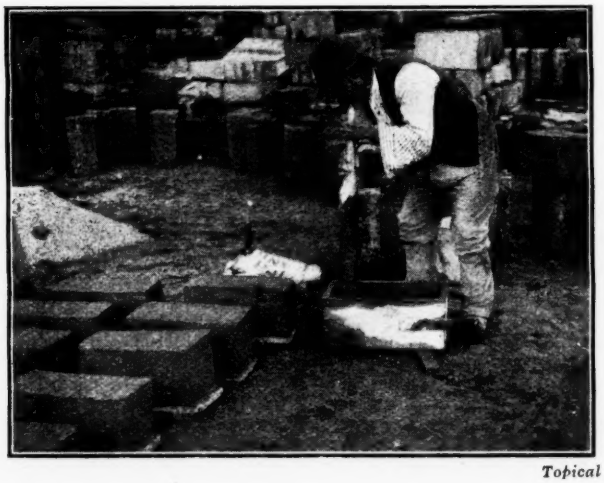
Preliminary steps are being taken to investigate the possibility of a central power station at Ponts Mill, near St. Blazey, the St. Austell Electric Co. being desirous of exploiting the powers they have to supply electricity to Fowey and other places. With a water supply at hand the suggestion is that power could be utilised by means of turbines.

Houses from Waste Clay Product

THE St. Austell district is solving the housing problem by the ingenious use of what, for the last 100 years, has been a waste product—the grit which is removed from the crude China Clay. This, when mixed with cement in the proportion

Topical

of one part to six of grit, makes excellent concrete blocks. Workmen employed in the China Clay pits are making these blocks in their spare time, and building their houses on land which is granted to them by their employers.



Topical

The photographs show (1) a man shovelling out the grit from the running stream of China Clay ; and (2) making the bricks.

Hauling Machinery in China Clay Mines

By China Clay "Captain"

IT is interesting to note the progress made, and the improvements introduced, in the hauling machinery and plant of the China Clay pits, even during the lifetime of those still actively engaged in the industry. Only the other week an old clay-worker was relating how the sand at many of the older works in the St. Stephens and St. Austell district was hauled by overshot waterwheels, while at some of the others where water power was not available a " horse-whem " was used. This was a contrivance with a vertical drum like a capstan, only instead of movable handspikes the horse was harnessed to a fixed arm and travelled in a circular path—a slow but sure engine of one h.p. indeed.

First Steam Engine

Just where and when and what kind of steam engine was first used I have not been able to ascertain. I remember seeing some of the early types ; one we used to call " the old pepper-grinder" : it made a tremendous whirr and clatter, enough to make one think the wagon was travelling at 50 miles an hour instead of only three miles per hour as it really was. I also call to mind a certain captain, a facetious joker, who used to say that *his* winding engine was washed up with Noah's flood—an antideluvian relic; but, however primitive in design, these early steam engines were a great advance on waterwheels and horse-whems, and no doubt were a great help in deepening the clay mines by speeding up the number of loads hauled per hour.

As time went on there were engines with vertical boilers, horizontal boilers, single and double-acting and compound cylinders, baker drums attached to rotary pumping engines with Cornish boilers, others taking steam from Lancashire boilers. The gear then varied from the simplest tooth-wheels to shrouded, bevel, helical and staggered teeth, while here and there " first action " drums might be seen. Many of the better kinds of steam winders are very efficient machines and in a reliability test would take a good deal of beating even now.

Gas and Crude Oil Engines

At some of the pits where the power is suction gas or crude oil, of course, hauling as well as pumping is done very economically from the fuel and driving standpoint ; but it is not always convenient to have the hauling engine and the " pumper " in the same place. As a matter of fact, generally they are on opposite sides of the clay mine, as it is a wise policy to keep the sand bank (quartz heap) away from the refining and settling plant to eliminate the danger of getting a high percentage of grit in the clay. When both engines are in one house it often means long winding ropes, sheave pulleys, pulley stands, etc., so I think the latest development, " the electric winder," has come to stay and is likely to become popular. A dynamo can be installed in the pumping plant house, the " juice " conducted to any side of the pit where required. A concrete bed can be laid down as foundation for drum and motor, you can run up a temporary corrugated iron house, fix your switchboard and in a few weeks you have a " winder " just where you need it, and if fitted with an electric controller or a sensitive friction clutch a very efficient machine results. And it is not such a big proposition to move it in case it is required at another place ; it is merely a case of scrapping the foundation and the rest would be movable.

A Directory of Paper Makers

THE 1925 issue of the Directory of Paper Makers of the United Kingdom has been published by Marchant Singer and Co., 47, St. Mary Axe, London, E.C.3. It has been authentically revised and in its present form constitutes a comprehensive and indispensable work for all concerned with the industry. It is intelligently indexed and includes such useful additional features as trade designations, classification of makes, with makers' names, paper trade customs, etc. The price is 5s. 6d., post free.

China Clay Producer's Unexpected Death

A WELL-KNOWN China Clay producer and merchant, Mr. James Perry, of Penvale, St. Austell, passed away at his residence on Good Friday morning, at the age of 69. Mr. Perry had been in ill-health for a short time and an operation was performed on Thursday, April 9. He was very well known in China Clay circles and had risen by his own efforts to a position of prominence in the business world. He has left a widow (his second wife), two sons, Messrs. S. B. and A. Perry, and a daughter (Mrs. H. L. Lodge). Mr. Perry was a native of Helston, and after being educated at Truro and serving an apprenticeship in the grocery business came to St. Austell nearly 40 years ago and became proprietor of Perry's Temperance Hotel. About 30 years ago, when the China Clay trade was developing, he became joint managing director of the old Central Treviscoe China Clay Co. at St. Stephens. He assisted the late Captain S. Dyer in the revival of the Trethowel China Clay Co., and on the death of Colonel Parsons became managing director of the Burthy China Clay Co. He was responsible for the formation of the New Halwyn China Clay Co. and also of Messrs. Dyer, Daley and Co., a merchanting firm. He was a keen supporter of the old Associated China Clays, Ltd., and a member of the China Clay Producers, Ltd., and of the China Clay Employers' Federation. For many years he was a valued member of the old St. Austell Urban Council, being twice Chairman, and only retired from the old Council this month. Mr. Perry was president of the local branch of the League of Nations Union, a keen educationalist and member of the local education authority, as well as a governor of the secondary school. He was an ardent temperance advocate, and in politics was a Liberal.

At the funeral on April 12 the China Clay trade and public bodies were largely represented.

Cornish China Stone

Its Value to the Ceramic Industry

CHINA stone, or Cornish China Stone, is a type of partially decomposed granite found only in the neighbourhood of St. Austell. It is closely allied to China Clay, and is sometimes found in the same quarry, but, being hard, it has to be blasted and quarried. There are several qualities of Cornish stone on the market—namely, hard purple, mild purple, dry white and buff stone, and the following are the analyses of these various qualities :—

1. SOLUBLE IN ACIDS.

	Hard Purple Stone.	Mild Purple Stone.	White Stone.	Buff Stone.
Aluminium oxide ...	2·12	1·89	11·52	3·48
Ferric oxide	1·92	1·61	0·56	0·61
Calcium oxide	0·44	0·48	0·54	1·08
Magnesium oxide ..	0·92	0·79	0·21	0·78
Alkalis	0·28	0·21	0·12	0·22

2. SOLUBLE AFTER FUSION.

Aluminium oxide ...	5·39	4·26	6·61	6·69
Ferric oxide	0·24	0·24	0·22	0·96
Calcium oxide	0·52	0·34	0·36	0·28
Magnesium oxide ..	0·41	0·34	0·42	0·48
Alkalis	1·81	1·04	2·26	2·68
Silica	85·64	88·56	73·72	82·56
Moisture	0·31	0·24	3·46	0·18
	100·00	100·00	100·00	100·00

Hard purple is a hard white rock with a purple tinge caused by the presence of purple fluorspar. Mild purple is a similar rock, but softer, and dry white is a soft white variety. Buff stone is similar to white, but is slightly tinged with yellow. It is sometimes asserted that any rock composed of felspar and quartz, and free from other minerals that might have a harmful effect on the colour or behaviour of the slip or paste, could be used as china stone. The granite pegmatite of St. Yrieux is one of such rocks; also the perphyrites of Saxony, the liparites of Japan, the felsitic of China, the fine-grained granite of Monteleras, in France, and others. These have the name of china stone, but experts know that they do not resemble Cornish china stone and that they do not possess the qualities necessary for the manufacture of the finest pottery.

Used by British and Foreign Potters

Cornish stone is employed largely by British potters and extensively by many foreign potteries and china factories, both in the body and in the glaze of wares. When added to an earthenware or porcelain paste it assists by its fusibility in the vitrification. In glazing mixture it is one of the less fusible ingredients and acts as a stiffener. The viscous quality it imparts to the molten glaze is particularly valuable in glazes used to cover prints on the biscuit ware, since it permits them to remain sharp in outline after firing.

Cornish stone vitrifies at the temperature of the earthenware biscuit oven, about 1,200 deg. C. When completely fused it forms a white enamel, which should be dense and compact, free from any appearance of frothiness. A frothy stone may cause pinholes and blisters in the glaze. Unlike China Clay, the employment of china stone is restricted to the ceramic and enamel industries.

China Clay and Mica

The Kaolinisation of Granite to Form China Clay

MANY theories have been advanced to explain the phenomenon of the kaolinisation of granite to form China Clay. It is generally agreed that water and carbon dioxide had more to do with kaolinisation than any other agents. Silica accounts for approximately 60 per cent. of the solid crust of the earth. It occurs in the free state as quartz and in the combined state as silicates, and it is as a silicate that it is of interest in the China Clay world.

Granite is composed of three well defined minerals :—Quartz, SiO_2; felspar, $NaAlSi_3O_8$; mica, $KHMg_2Al_2(SiO_4)_3$. The felspar may be a soda-, a potash-, or a lime-felspar, or a mixture of the three, while the micas can have several complicated formulæ of the type indicated. These minerals, and especially the micas, are complex owing to the formation by "vicarious replacement" of one element by another, of isomorphous mixtures to which no simple chemical formula can be given. Thus in the micas potassium may replace sodium, ferrous iron may replace calcium, and ferric iron may replace aluminium. The chemical analyses of China Clays conform closely to the formula $Al_2O_3 2SiO_2 2H_2O$ with small and variable proportions of calcium, magnesium, and iron. Iron is the chief of the so-called impurities in China Clay. This is only to be expected since if iron existed side by side with an aluminium silicate, and China Clay is essentially a hydrated silicate of aluminium, and conditions were favourable, ferric iron would replace trivalent aluminium or at any rate would slip in alongside the aluminium.

Water under pressure is an efficient solvent and the common rock forming minerals are all capable of solution in water. Felspar can be converted by the action of water and carbon dioxide into mica. Two-thirds of the potash is eliminated as potassium carbonate and two-thirds of the silica as shown by the equation :

$$3KAlSi_3O_8 + H_2O + CO_2 = KH_2Al_3Si_3O_{12} + 6SiO_2 + K_2CO_3$$

Muscovite

Muscovite is one of the simplest micas, and the reaction outlined above may account for its presence in granite. Muscovite is not found in lavas since when heated it decomposes further with loss of alumina and silica to give leucite, $KAlSi_2O_6$. Felspar can undergo another decomposition in which the whole of the potash is eliminated and two-thirds of the silica to give rise to kaolinite, as shown by the equation :

$$2KAlSi_3O_8 + 2H_2O + CO_2 = H_4Al_2Si_2O_9 + 4SiO_2 + K_2CO_3$$

The micas are remarkable for their resistance to weathering. Their crystallisation precedes that of felspar, and their decomposition or weathering is not as complete as that of felspar. They would, in part, appear to be intermediate products or perhaps better the result of side reactions which proceeded concurrently with the main reaction, the formation of kaolinite from felspar. China Clay, however carefully washed, generally contains in addition to kaolinite some "mica," "mica" in the sense it is used and understood in the trade, and this mica accounts in large measure for the presence of potassium, sodium, calcium, magnesium and iron in ordinary China Clay.

The above facts go to indicate that that the water-carbon dioxide theory of kaolinisation has a sound scientific basis.

China Clay Notes and News

China Clay Exports from Johore

The Colonial Office report for 1923, just issued, says that 49¾ tons of China Clay were exported from workings at Sungei Perpat. The works are being enlarged with the object of turning out 600 tons a month. At present the clay is being exported to India, but it is hoped to arrange also for export to America and to undertake the manufacture of latex cups, tiles, and rice bowls.

New Paper Mills in Tasmania

In the annual report of the Tasmanian Hydro-electric Department it is stated that there are prospects of a large factory for the manufacture of wood pulp and paper being established on the north-west coast. The industry will probably involve a capital expenditure of approximately £3,000,000. At first about 4,000 electric horse power would be required, and present indications are that a further 1,000 h.p. would be utilised within a year or two.

China Clay in Paper

At St. Austell Rotary Club luncheon on April 8, Rotarian H. E. Warne, in the course of a paper on printing, mentioned that for the three-colour printing process a highly finished paper was necessary, in the production of which the very best qualities of China Clay were used. For news-print paper cheaper grades of clay were utilised, about 15 per cent. of China Clay being used. In every edition of a newspaper with a million circulation, 20 tons of China Clay were required.

Par Stationmaster Retires

Mr. William Doney, who has been stationmaster at Par for 15 years, is retiring shortly, after over 44 years' service with the Great Western Railway. He joined the old Cornwall Railway Co. in 1880, starting as a porter. For 11 years he was a stationmaster at Burngullow, and worked for a short time in the same capacity at Grampound Road and Par. Mr. Doney has been a member of Tywardreath Parish Council, treasurer of Par and District Brotherhood, and Chairman of the Cornish Tent Co., Ltd.

More Electrification of Clay Works

The electrification of China Clay works proceeds rapidly, and is largely due to the high price of coal for power purposes. John Lovering and Co., who have electrified some of their other works, are putting in a couple of Diesel engines at Carbean, near St. Austell, to generate electricity for power purposes to their bunch of works in that vicinity, including Cleaves, Higher and Lower Ninestones, and Bluebarrow. The old steam engines will not be scrapped, but will be used as auxiliaries in case of emergency. Loverings have already proved the success of electrical plant at their Meledor works.

St. Austell County Court Changes

In future the chief office for the County Court will be at Truro, with Mr. Chilcott as Registrar, St. Austell becoming in the same way as Falmouth, a sub-office. The change has arisen through the resignation of Dr. H. Newcombe Wright as Registrar of the St. Austell Court, the new arrangement having been made by the Lord Chancellor. Mr. T. T. Kneebone, who has been chief clerk for many years, will continue to serve in that capacity, but the St. Austell office will be open in future on Tuesdays and Fridays only. The Truro County Court office will be the principal office for the St. Austell Court. The St. Austell sittings will be as heretofore.

Paper-making in the Transvaal

During a discussion at the Commercial Congress at Johannesburg of the detrimental effects of dumping on South African industries, Mr. W. D. Fulton, a director of the Premier Paper Mills, Klip River, Transvaal, said: "We have discovered a raw material in South Africa which will make a better paper than is produced in any other country." Mr. Fulton mentioned that a thousand tons of "newsprint" was used each month. This, multiplied by 12, gave some idea of the amount of money going out of the country annually for newspaper consumption alone. There was ample raw material in the Transvaal to last a mill producing 1,000 tons a month for 50 years. "We have ample supplies in the Transvaal," added Mr. Fulton, "to last out the mills 200 years, without counting other parts of South Africa."

Greater St. Austell Embraces Charlestown

On April 1 the new extended urban area of St. Austell came into operation, and now embraces the China Clay seaport of Charlestown. The population of the town is now increased to nearly 9,000, and is the centre of a population of 36,000. With the passing out of the old Urban Council, the St. Austell central local governing body has lost its two remaining members who had associations with the China Clay industry. They are Mr. H. S. Hancock, who served on the Council throughout its existence of 30 years, and Mr. James Perry, who had been a member over 20 years. On the new Council, China Clay is not so directly interested, but three of its members are indirectly concerned—Mr. F. W. Mutton, a China Clay master cooper, who is financially interested in China Clay, Mr. E. W. Galley, who is in the accountants' dept. of English China Clays, Ltd., and Mr. R. H. Luke, a director of a China Clay Company.

China Clay Merchants on New Council

There was keen competition for seats on the St. Austell Rural District Council, the elections for which took place on April 4. Several candidates connected with the China Clay industry went to the poll, the only two who were defeated being Mr. John Hoyle, China Clay producer, an old councillor for St. Mewan parish, and Mr. R. H. Tabb, clay labourer, who sought election as a new member for St. Dennis. Mr. Richard Hooper, works manager for H. D. Pochin and Co., Ltd., one of the oldest members on the Council, retained his seat for St. Dennis. Mr. F. Venner, china-stone quarryman, retained his seat as a representative for St. Stephen's parish, he being joined by two new members—Mr. J. P. Goldsworthy, clay works manager, and Mr. T. C. Harris, of Meledor, clay works foreman. Mr. W. T. Nicholls, China Clay merchant, of Hallaze, interested in North Goonbarrow China Clay Works, was successful as a representative of St. Austell parish.

A Railway Development Suggestion

Commenting on the development of Greater St. Austell, a correspondent writes:—The town and district should now make a strong appeal to the G.W. Railway to help in its development as well. Visitors inform us that they don't know of a passenger station so badly placed as ours, and its condition cannot very well be obviated, seeing that it is sandwiched between clay and coal all the year round. The G.W.R. in their own interests should make a short loop line to Pentewan Road, and transfer all coal, clay and heavy goods there. With this carried out and the new road completed, all clay, coal and other heavy traffic would be diverted from Fore Street. This would be very helpful to the clay carriers, coal merchants and gas company, as well as those good people residing near the station. In addition to this, it would be money well spent by the railway company, as they would have practically unlimited siding accommodation (which, unfortunately, is sadly lacking at present), and the merchants of the town and district would be able to erect their stores alongside the sidings and thereby save cartage and transport.

Mr. Sydney Hancock Retires from Public Work

The retirement from public work, after forty years in harness, of Mr. Sydney Hancock marks an epoch in the history of St. Austell as well as for the subject of our sketch. Mr. Hancock has crowded into 75 years of life enough activity to suffice for three ordinary men, and, to adopt the slogan of a famous beverage, is "still going strong" so far as physical and mental capacity are concerned. As a professional man Mr. Hancock has been associated with many estates. He has been auctioneer for the Lanhydrock Estates for a great number of years, and for the last two years has been chief

steward. His father was surveyor for Penrice Estate, and he has served in a similar capacity for over 40 years, and for the same period has been valuer for the Charlestown Estate. He was manager of Thriscutt and Bales' Caudledown China Clay Works for twenty years, until it was purchased three or four years ago by Grose and Stocker. He still retains the position of advisory manager. For 27 years he has served Gill and Ivimey in the capacity of the Reeve of the Manor of Treverbyn. He has also been surveyor of the Lambe Estate for many years. He has seen the opening and extension of numerous clay works in Mid-Cornwall, and has surveyed and drawn more plans of clay works than any other man in Cornwall.

Mr. Hancock's first public office was his election as a way-warden on the old Rural Highway Board, 40 years ago. He was subsequently for five years a member of the old Local Board, the immediate predecessor of the Urban Council, of which he was one of the original members throughout its existence of 30 years. He holds the record chairmanship of six years, having held the office in 1897, 1906, 1909–10, 1915–16. It was in recognition of his making the gift of a civic badge—which he wore for the first time on the occasion of the visit to the town of the King and Queen in 1909, as Prince and Princess of Wales—and his scheme of the gold links to form the chain, that he was re-elected to the chair, the first time that any chairman had been accorded the honour two years in succession. He completed the handsome chain which is now worn by successive chairmen, every link of which he collected from individuals having old or present associations with the town.

Though retiring from his civic and municipal public work, Mr. Hancock is remaining in touch with business and parochial activities. He carries with him into comparative retirement the good wishes of all who value public service.

St. Austell Banker's £115,000 Will

Mr. Daniel Henry Shilson, of Trewhiddle, St. Austell, formerly of the old bank of Shilson, Coode and Co., of St. Austell (now absorbed in the National Provincial Bank), and of the firm of solicitors of that name, left £115,228, with net personalty £81,924. Probate has been granted to Mr. Philip Melville Coode and Mr. Alan Penrose Coode, solicitors, of St. Austell. Details of his will are as follows :—

£1,000 to the Royal Cornwall Infirmary ; £1,000 to the St. Austell Nursing Association ; £500 to the United Kingdom Beneficent Association ; £250 to St. Austell Parish Church Council on trust for investment, and to apply the income in the upkeep of the Baptistry in Holy Trinity Church, St. Austell (erected by him as a memorial to his wife), and any balance of the income not required for that purpose for the upkeep of the Church ; £1,500 to his late wife's maid, Rose Brokenshire ; £1,000 to his gardener, William Henry Crocker, whether still in his service or not, and the use for life of Rose Cottage, New Mills, St. Austell, with remainder to his wife for her life it she should survive him ; £350 to his chauffeur, Reginald Legassick ; £250 to his housekeeper, Ellen Dawe ; £100 to his workman, Richard Oliver ; one year's wages to each other domestic servant of 12 months' service ; £100 to Thomas C. Matthews, clerk to Messrs. Coodes, solicitors, of St. Austell ; £1,000 each to Edward Snow Martin, late manager of the National Provincial Bank, St. Austell, and Philip Melville Coode and Alan Penrose Coode, solicitors, of St. Austell.

Other bequests included £2,000 each to his cousin Blanche Dinham King, his late wife's cousin, Edith Gummoe, and his friends Marianne R. G. Sawle and Amy Trevanion Noon ; £1,000 each to his wife's cousins Henry Dowrish Drake, Mary Haynes and Anna Wells ; £1,000 to Lilian M. Burchell ; £500 each to the eight godchildren of himself or his late wife—Evelyn Julia Moulton, Ernest James Patch Nankivell, Henry Shilson King, Beatrice Wells, Amy Elizabeth Noon, Elizabeth Coode, Mavis Perkins and Elizabeth Noad ; 100 guineas as a memento to his friend Julia Rodd ; and an annuity of £20 to Elizabeth Lidgey. All other of his property he left to his cousin, William Kendall King. Mr. W. Kendall King, the heir to the residue of the estate, has taken up his residence at Trewhiddle. Like Mr. Shilson, he is a keen golfer, and was recently elected a vice-president of the St. Austell Club. Mr. King is a retired bank manager, and was living at Topsham, near Exeter, when the news reached him after Mr. Shilson's death in January at the age of 85. He has been Mayor of Exeter.

Fortune Made from Ball Clay

Mr. C. D. Blake leaves £555,751

Mr. Charles Davey Blake, of Highwood, Newton Abbot, chairman of Watts, Blake, Bearne and Co., Ltd., clay merchants, and a director of other companies, who died on January 1 in his 87th year, left a fortune of £555,751 18s. 2d., with net personalty £513,674 10s. 1d.

The testator left the use and enjoyment of Highwood and the furniture and an annuity of £1,000, and an additional £250 a year for the upkeep of Highwood, to his wife ; an annuity of £104 and the use of the premises called Hillside to Elizabeth Jane Carnell ; an annuity of £300 to his nephew, Charles Edward Strickland ; annuities of £104 each to Bessie Redmore, Reginald Davey and Ellie Davey, and a number of small annuities. Until the death of the last of the personal annuitants under his will he gives £100 a year to the Newton Abbot Congregational Church, £100 a year to the Kingsteignton Congregational Church, £50 a year to the Chudleigh Congregational Church, £50 a year to the Bovey Tracey Congregational Church and £13 a year to the Newton Abbot Salvation Army ; and on the death of such last annuitant a further £2,000 each to the Newton Abbot and Kingsteignton Congregational Churches, £1,000 each to the Chudleigh and Bovey Tracey Congregational Churches. The ultimate residue of the property he leaves to the Congregational Union of England and Wales, one-half of the income to be paid to the Devon Congregational Union.

A Shrewd Business Man

Mr. Blake was a shrewd business man and his wealth came principally from the great ball clay deposits in the Teign basin, in the immediate vicinity of Newton Abbot, Kingsteignton and Chudleigh. Besides being the head of Watts, Blake, Bearne and Co., one of the oldest-established clay firms in Mid-Devon, Mr. Blake was intimately associated with sister industries in the district. The old china potteries at Bovey Tracey were in a state of decay when many years ago he interested himself in them and enabled their return to prosperity. He was instrumental in establishing the well-known brick and tile works at Kingsteignton, under the style of Hexter, Humpherson and Co. He was also financially interested in potteries at Bristol and in Staffordshire. Although in his later years he was blind and often confined to his room, he never relaxed his grip of business.

Mr. Blake never took any part in public work, though he was ever ready to assist in what he deemed to be deserving causes. He was a strong Liberal and Free Trader. As a Congregationalist Mr. Blake was always a generous supporter of the Nonconformist cause. It was largely through his aid that the spire was added to the tower of Newton Abbot Congregational Church, which had remained unfinished for many years. Many of his gifts were anonymous.

A person seeking an interview with him found himself drawn into a conversation in a manner that was irresistible, and no man was shrewder in gaining information from others. Without adopting dictatorial or overbearing methods Mr. Blake could always get at the root of a subject in a marvellous way. It is characteristic of Mr. Blake that in his bequests he has benefited causes in the district from which he drew much of his wealth, notably Newton Abbot, Kingsteignton, Bovey Tracey, and Chudleigh ; in addition to which Devon Congregationalism as a whole is to benefit ultimately by half the income from the residue of the estate.

China Clay Beds in Ontario

Mr. C. M. McCarthy, a Toronto diamond driller and prospector, reports China Clay discoveries in Northern Ontario, according to *Pulp and Paper*. Mr. McCarthy staked in 1917 two China Clay claims on the Metagami River. The two claims are estimated to contain about 40,000,000 tons. Some years ago Professor Keel, then head of the clay branch of the department at Ottawa, saw the deposit and described it as the finest in Canada. This clay has just lately been tested for Mr. McCarthy at Georgetown by the Georgetown Coated Paper Co. He is also having tests made in England and the United States. It is stated that the clay analyses from 52 to 54 per cent. silica, about 30 per cent. alumina, 1·13 per cent. iron oxide, a slight trace of lime and magnesia, and a fair amount of moisture.

Shipping and Export News of the Month

We give below the latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—March, 1925

Arrived	Name	Sailed	Destination
Mar. 1, S.S.	*Herfinn*	Mar. 6,	Porsgrund
Mar. 1, S.S.	*France Maru*	Mar. 12,	Portland, Me
Mar. 2, S.S.	*Falmouth Castle*	Mar. 6,	Weston Point
Mar. 2, S.S.	*Porthmeor*	Mar. 6,	Manchester
Mar. 2, S.S.	*Abercraig*	Mar. 7,	Ridham
Mar. 3,	*Margrethe*	Mar. 11,	Fredrikshald
Mar. 4, S.S.	*Mount Charles*	Mar. 7,	Lancaster
Mar. 4, M.V.	*Katie*	Mar. 12,	London
Mar. 5, M.V.	*Grietze*	Mar. 10,	Karlskrona
Mar. 5, S.S.	*Jacinth*	Mar. 7,	Runcorn
Mar. 5, S.S.	*Onyx*	Mar. 7,	Preston
Mar. 5, S.S.	*Pylades*	Mar. 7,	Bo'ness
Mar. 5, S.S.	*Philotis*	Mar. 7,	Harburg
Mar. 5,	*Hector Cundy*	Mar. 10,	Par
Mar. 5, S.S.	*Overton*	Mar. 10,	Charlestown
Mar. 5,	*Cornwall*	Mar. 11,	Liverpool
Mar. 5, M.V.	*Elbnixe*	Mar. 11,	Passages
Mar. 5,	*Louise*	Mar. 20,	Weston Point
Mar. 6, S.S.	*Brier Rose*	Mar. 9,	Ridham
Mar. 6, S.S.	*Vertrauen*	Mar. 11,	Terneuzen
Mar. 6, S.S.	*Shoreham*	Mar. 10,	Preston
Mar. 7,	*Irish Minstrel*	Mar. 20,	Irvine
Mar. 7,	*Adelaide*	Mar. 20,	Weston Point
Mar. 7,	*Hansea*	Mar. 18,	Harburg
Mar. 8, S.S.	*Manfred*	Mar. 12,	Oscarsham
Mar. 8, S.S.	*Cornish Merchant*	Mar. 12,	Rouen
Mar. 8, S.S.	*Sikla*	Mar. 13,	Norrkoping
Mar. 9, S.S.	*Bruxelles Maritime*	Mar. 10,	Grimsby
Mar. 9, S.S.	*Gouwestroom*	Mar. 14,	Amsterdam
Mar. 11, S.S.	*Ebbrix*	Mar. 13,	Grimsby
Mar. 11, M.V.	*August Shieloh*	Mar. 13,	Gothenborg
Mar. 11, S.S.	*Calluna*	Mar. 14,	Brussels
Mar. 11, S.S.	*Orchis*	Mar. 16,	Grimsby
Mar. 11, S.S.	*Everest*	Mar. 16,	Portland, Me
Mar. 11, S.S.	*Ashton*	Mar. 14,	Antwerp
Mar. 12, S.S.	*Hammershus*	Mar. 21,	Philadelphia
Mar. 12, S.S.	*Estella*	Mar. 18,	Antwerp
Mar. 13, S.S.	*Monksville*	Mar. 18,	Preston
Mar. 13, M.V.	*Lynetten*	Mar. 18,	Rouen
Mar. 14, S.S.	*Bronzite*	Mar. 20,	Antwerp
Mar. 14, M.V.	*Kongedybet*	Mar. 19,	Odense
Mar. 14, S.S.	*Katherine*	Mar. 14,	Falmouth
Mar. 14, S.S.	*Pentowy*	Mar. 21,	Philadelphia
Mar. 14, S.S.	*Falmouth Castle*	Mar. 18,	Runcorn
Mar. 16, S.S.	*Eskbridge*	Mar. 27,	Newport News
Mar. 16, S.S.	*Lavenberg*	Mar. 26,	Portland, Me
Mar. 16, S.S.	*Shellie*	Mar. 19,	Rochester
Mar. 16, S.S.	*Ravenspoint*	Mar. 20,	Genoa
Mar. 17, S.S.	*Westdale*	Mar. 21,	Fleetwood
Mar. 17, S.S.	*Topaz*	Mar. 20,	Weston Point
Mar. 17, M.V.	*Lydia Cardell*	Mar. 25,	Rouen
Mar. 18, S.S.	*Whinhill*	Mar. 23,	Preston
Mar. 18,	*Helena Anna*	Apl. 1,	Runcorn
Mar. 18,	*Harris*	Mar. 30,	Kirkcaldy
Mar. 18, M.V.	*Dietrick Hasseldich*	Mar. 21,	Harburg
Mar. 18, M.V.	*Hinrich Luhring*	Mar. 24,	Harburg
Mar. 19, S.S.	*Pichmere*	Mar. 25,	Liverpool
Mar. 19,	*Galathea*	Apl. 11,	Leith
Mar. 19, S.S.	*Harlaw Plain*	Mar. 27,	Runcorn
Mar. 19, M.V.	*Drogden*	Mar. 25,	Seville
Mar. 20,	*Frances and Jane*	Apl. 8,	Rochester
Mar. 20,	*Lisa*	Mar. 30,	Fredrikshald
Mar. 20,	*Ada*	*	Rochester
Mar. 20, S.S.	*T. P. Tilling*	Mar. 25,	Fleetwood
Mar. 20, S.S.	*Greta*	Mar. 30,	Boston, Mass.
Mar. 21, S.S.	*Claretta*	Mar. 28,	Preston
Mar. 23, S.S.	*Essonite*	Mar. 26,	Runcorn
Mar. 23, S.S.	*Maria*	Mar. 26,	Harburg
Mar. 23,	*Lucy*	*	Queensborough
Mar. 24, S.S.	*Edern*	Mar. 27,	Birkenhead
Mar. 24,	*Cornwall*	Apl. 7,	Rochefort
Mar. 25, S.S.	*Farfield*	Mar. 28,	Terneuzen
Mar. 25, S.S.	*Soborg*	Apl. 1,	Baltimore
Mar. 25, S.S.	*Ferndene*	Mar. 30,	Antwerp
Mar. 26, S.S.	*Mercurius*	Mar. 30,	Sarpsberg
Mar. 26,	*Gauntlet*	Apl. 8,	Rochester
Mar. 26, S.S.	*Velocity*	Mar. 27,	Newlyn
Mar. 26, M.V.	*Lynetten*	Apl. 2,	Bilbao
Mar. 27, S.S.	*Enid Mary*	Mar. 31,	Rouen
Mar. 27, S.S.	*Vikfred*	Mar. 28,	Drammen
Mar. 27, S.S.	*Plas Dinam*	Apl. 1,	Antwerp
Mar. 27, S.S.	*Procris*	Apl. 2,	Hamburg
Mar. 27, M.V.	*Antigoon*	Apl. 2,	Antwerp
Mar. 28, S.S.	*Randi*	Apl. 2,	Leghorn
Mar. 28, S.S.	*Ciscar*	Apl. 3,	Genoa
Mar. 29, S.S.	*Elizabetta*	Apl. 2,	Runcorn
Mar. 29, S.S.	*Tanny*	Mar. 31,	Newlyn
Mar. 29, S.S.	*Glen Mary*	Apl. 2,	Bristol
Mar. 30, S.S.	*Rossmore*	Apl. 3,	Bo'ness
Mar. 30, S.S.	*Falmouth Castle*	Apl. 2,	Runcorn
Mar. 31, S.S.	*Orchis*	Apl. 3,	Ridham
Mar. 31, S.S.	*Dragoon*	Apl. 3,	Liverpool
Mar. 31, S.S.	*Lakewood*	Apl. 4,	Passages

* Signifies " In Port."

Charlestown Shipping—March, 1925

Arrivals

Date.	Vessel.	From
February 28	*James Tennant*	Kingsbridge
February 28	*Alice Williams*	Falmouth
February 28	*Lady Daphne*	Truro
March 5	*Bulla*	Falmouth
March 6	*Englishman*	Par
March 7	*Treleigh*	Barry
March 7	*Olive*	Penzance
March 9	*Western Lass*	Mevagissey
March 10	*Sutton*	Plymouth
March 11	*Cornwall*	Fredrikshamn
March 12	*Conis Crag*	Penzance
March 14	*Amanda*	Looe
March 19	*Lady Agnes*	Mevagissey
March 20	*Araoh*	Plymouth
March 21	*Nalan*	Topsham
March 21	*Lady Rosebery*	Torquay
March 22	*Lady Thomas*	Barry
March 25	*Charbomire*	DeWitte
March 27	*Trader*	Jackson
March 28	*Corgan*	Whelan
March 28	*Mary Barrow*	Newport
March 30	*Pacific*	Tyrrell

Sailings

Date.	Vessel.	Destination.
March 6	*Lady Daphne*	Rochester
March 7	*James Tennant*	London
March 10	*Alice Williams*	Newcastle
March 10	*Englishman*	London
March 11	*Olive*	Fleetwood
March 12	*Bulla*	London
March 13	*Sutton*	Barrow
March 14	*Conis Crag*	London
March 21	*Amanda*	Runcorn
March 23	*Western Lass*	Western Point
March 23	*Lady Agnes*	Goole
March 24	*Araoh*	Boulogne
March 24	*Nalan*	Terneuzen
March 25	*Lady Rosebery*	Rochester
March 26	*Lady Thomas*	Preston
March 27	*Charbomire*	Brussels
March 27	*Trader*	Sunderland

Par Harbour Shipping—March, 1925

Arrivals

Date.	Vessel.	From
March 3, M.V.	*Leeuwerick*	Antwerp
March 6, M.V.	*Haldon*	Kingsbridge
March 6, S.S.	*Robrix*	Plymouth
March 7, S.V.	*Kate*	Plymouth
March 7, S.V.	*Sunshine*	Mevagissey
March 9, S.V.	*Triumph*	Plymouth
March 9, S.V.	*Hope*	Polkerris
March 10, S.V.	*Hector Cundy*	Fowey
March 10, S.V.	*M. A. James*	Runcorn
March 11, S.S.	*Treleigh*	Charlestown
March 11, S.V.	*Kate*	Plymouth
March 11, S.V.	*Christian*	Bantry
March 12, S.V.	*Pursuit*	Penryn
March 13, S.V.	*Two Sisters*	Falmouth
March 13, S.V.	*Emily Warbrick*	Falmouth
March 14, S.S.	*Edith*	Plymouth
March 18, S.V.	*May Blossom*	Plymouth
March 22, S.V.	*Fanny Crossfield*	Totnes
March 24, S.V.	*Snowflake*	Runcorn

March 24,	S.S. *Towy*	Penryn
March 25,	S.S. *Fernside*	Penryn
March 25,	S.S. *Reedness*	Truro
March 25,	S.S. *Vikfred*	Exmouth
March 25,	S.S. *Moorside*	Penzance
March 25,	S.S. *The Lady Belle*	Truro
March 27,	M.V. *Katie*	London
March 27,	S.V. *Naiad*	Plymouth
March 29,	S.V. *Genesta*	Falmouth
March 29,	S.V. *Wilhelmina*	Falmouth

Sailings

Date.	Vessel.	Destination.
March 1,	M.V. *Press On*	Plymouth
March 1,	S.V. *Triumph*	Plymouth
March 6,	S.V. *Englishman*	Charlestown
March 8,	M.V. *Leeuwerik*	Antwerp
March 9,	M.V. *Hope*	Polkerris
March 10,	S.S. *Bruxelles Maritime*	Grimsby
March 10,	M.V. *Haldon*	Penarth
March 10,	S.S. *Robrix*	Gravesend
March 10,	S.V. *Kate*	Plymouth
March 10,	S.V. *Triumph*	Plymouth
March 11,	S.S. *Treleigh*	Preston
March 12,	S.V. *Amy*	Leith
March 12,	M.V. *Hope*	Pentewan
March 14,	S.V. *Kate*	London
March 15,	S.V. *Hector Cundy*	St. Malo
March 16,	S.S. *Edith*	Pentewan
March 18,	S.V. *May Blossom*	Pentewan
March 23,	S.V. *Pursuit*	Goole
March 24,	S.V. *Duchess*	London
March 24,	S.V. *M. A. James*	Rochester
March 25,	S.V. *Christian*	Skien
March 25,	S.V. *Two Sisters*	London
March 27,	S.S. *Towy*	Bristol
March 27,	S.S. *Vikfred*	Fowey
March 27,	S.S. *My Lady Belle*	Gaston
March 28,	S.S. *Fernside*	Dundee
March 28,	S.S. *Reedness*	Terneuzen
March 28,	S.S. *Moorside*	Dunkirk

Par Harbour Tide Table, April, 1925

(Greenwich Mean Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Saturday	18	0.39	1.22	10.1
Sunday	19	2.3	2.38	10.8
Monday	20	3.11	3.40	11.8
Tuesday	21	4.5	4.29	12.6
Wednesday	22	4.52	5.12	13.1
Thursday	23	5.32	5.51	13.3
Friday	24	6.10	6.27	13.4
Saturday	25	6.45	7.0	13.1
Sunday	26	7.16	7.33	12.6
Monday	27	7.40	8.7	11.11
Tuesday	28	8.22	8.38	11.2
Wednesday	29	8.57	9.18	10.3
Thursday	30	9.39	10.5	9.5

E. CLEMENS, Harbour Master.

March China Clay Deliveries

MARCH proved an unusually busy month, the record total of 98,598 being despatched. The nearest approach to this handsome total within the last 15 months was in May last year, when 87,262 tons were sent away, including 2,892 tons of Ball Clay sent through Fowey and Plymouth. March showed a total increase in all classes on February (which was a short working month) of 27,685. China Clay accounted for an increase of 27,354. Ball Clay was down compared to February by 910 tons. Below is given the detailed figures and comparisons with immediately preceding months :—

	China Clay. Tons.		China Stone. Tons.		Ball Clay. Tons.		Total Tons.	
Port.	1925.	1924.	1925.	1924.	1925.	1924.	1925.	1924.
Fowey	74,455	59,580	2,526	3,495	1,825	2,297	78,806	65,372
Charlestown	4,287	3,100	—	—	—	—	4,287	3,100
Par	4,606	4,400	—	651	—	—	4,606	5,051
Plymouth	1,670	1,059	—	6	30	—	1,700	1,065
Looe	150	157	—	—	—	—	150	157
Penzance	3,721	—	—	—	—	—	3,721	—
Falmouth	180	—	—	—	—	—	180	—
By Rail	5,148	5,895	—	—	—	—	5,148	5,895
Totals	94,217	74,191	2,526	4,152	1,855	2,297	98,598	80,640
February	66,863	52,244	3,436	1,575	614	1,118	70,913	54,937
January	74,490	56,686	2,506	3,978	3,050	1,567	81,046	62,231
December	—	64,860	—	2,613	—	3,083	—	70,926
November	—	71,546	—	3,912	—	1,238	—	76,696
October	—	80,197	—	3,693	—	2,821	—	86,711

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

*[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]*

FAREHAM BRICK AND TILE CO., LTD. Registered March 13, £11,000 debenture, to Branch Nominees, Ltd., 15, Bishopsgate, E.C.; general charge. *——. August 4, 1924.

FONTLEY BRICK AND TILE CO., LTD. Registered March 13. £11,000 debenture, to Branch Nominees, Ltd.; general charge. *£18,174 19s. June 25, 1924.

HENDON PAPER WORKS CO., LTD., Sunderland. Registered March 23, £130,000 (not ex.) further charge (inclusive of £100,000 (not ex.) secured by mortgage dated April 20, 1923), and deed (supplemental to collateral debenture of same date), to bank; charged on properties at or near Sunderland, and general charge. *£85,422. October 29, 1924.

PENRICE CHINA CLAY CO., LTD., Hayle. Registered March 19, £500 debentures, part of £3,000; general charge. *——. July 2, 1924.

SALOP POTTERY CO., LTD., Broseley. Registered March 14, £1,000 debenture and £1,000 debenture, to S. Wolfson, 225, Hagley Road, Edgbaston, merchant, and Mrs. R. Wolfson, 85, Grange Road, Smethwick; general charge. *Nil. January 21, 1924.

Satisfaction

FONTLEY BRICK AND TILE CO., LTD. Satisfaction registered March 12, £6,000 and as additional security for £12,000, registered March 17, 1922.

China Clay Imports for March

A RETURN showing the registered imports of China Clay (including China Stone) into Great Britain and Northern Ireland from the several countries of consignment during the month of March, 1925.

COUNTRY WHENCE CONSIGNED.	QUANTITY. Tons.	VALUE £
Germany	102	661
U.S. America	20	150
Total	122	811

English China Clays, Ltd.

THE directors of English China Clays, Ltd., in their report for the year ended December 31, 1924, record a net profit of £85,879, compared with £91,918 for the preceding year. The payment of the preference dividend and 4½ per cent. on the ordinary shares for the year absorbs £78,323. Out of the £13,987 brought forward from the preceding year, £10,000 is transferred to general reserve, leaving, with the balance of last year's profits, a balance of £11,543 to carry forward.

The directors state that "The demand for China Clay, both for home consumption and for export, has shown considerable expansion, notwithstanding the fact that the Russian and Central European markets are still comparatively negligible, and if the prices had remained stable throughout the whole of the period the result of the year's working would have been materially better. As notified by letter to the shareholders on October 4, the Associated China Clays, Ltd., terminated in September; there immediately followed a lowering of prices which has affected the profit earned in the last quarter of a year. Taking the circumstances into consideration, your directors venture to hope the accounts for the year will be considered satisfactory."

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., 8, Bouverie Street, London, E.C.4. All communications relating to Advertisements, Subscriptions and other business should be sent to the Manager, "The China Clay Trade Review," at the same address. Telegrams—"Allangas, Fleet, London." Telephone—City 9852 (6 lines).

English China Clay as Paper "Filler"

From a Correspondent

Now that the production of paper has reached such an immense volume, manufacturers might very well pay even more attention to the use of English China Clay, which is a valuable adjunct to the paper industry. The clay—"paper clay" as it is called, when employed in this manufacture—is added in suspension in water to the prepared pulp during the first process of beating or breaking up and mixing with water. The object of adding the paper clay is to fill up the interstices between the fibres of the pulp, so that a more smooth and solid surface may be imparted. This also increases the weight of the paper. The kind of surface thus produced is particularly in request by printers of half-tone photo-mechanical blocks. It is impossible to print from such blocks on a paper that presents a fibrous surface.

Its Affinity for Printers' Ink

China Clay or paper clay, and other mineral and chemical substances which are used for similar purposes, are known in the trade as "fillers" or "loaders." Many paper-makers still cling to these other "fillers," but it is claimed by those who have used them that none of them remains so well in suspension in the pulp as China Clay, nor do they have the same affinity for printers' ink and aniline dyes, one of the most important properties of English clay in this connection.

Only the purest and whitest kaolins are suitable for the fine grades of paper; less pure varieties are employed for the coarser grades, wall papers, and some browns. Even for coloured papers, white clay is preferred, as more constant results are obtained by adding the requisite pigments to a pulp with white clay. Some fine printing papers are prepared by treating the web with a coating made of an emulsion containing China Clay.

Improving Paper for Illustrations

In addition to its use as a "filler" in paper-making, English China Clay is also used as a coater and glazer, the best clay giving that fine surface to highly-finished papers. Newspaper pulp normally carries from 15 to 25 per cent. of China Clay. With the cost of other paper-making materials and the lessening quantity of those materials for "news," it might very well carry more. Paper-makers might give greater attention to the extended use of this raw material in these times of growing demands for surface papers for the printing of pictures.

China Clay has long been used as an important ingredient in the manufacture of paper other than that for "news." It has the property of rendering the paper smooth and opaque, as well as of serving other purposes no less important to the manufacturers. It is readily incorporated with the fibre, and if very finely divided, will adhere very closely to it.

Some years ago, a great deal was heard about adulterated paper, but it was soon shown that with the use of China Clay, excellent papers could be sold at prices at which even passable "pure paper" could not be made. Almost any pulp can by this means be converted into excellent writing paper; and before this fact became generally known, very large fortunes were quickly made by those in the secret.

Early China Clay Coating Methods

As to the manner in which China Clay was first used in paper, the following particulars of the process adopted by paper-makers who realised its value when coated papers were in their infancy, will be found interesting, if novel, by present-day paper-makers who have improved on it in various directions.

Properly to dissolve the clay for mixing it with the pulp, a vessel was provided, equipped with a steam pipe, and with an agitator of adequate construction, set in motion by a belt and pulley. The clay was put into the vessel, which was then filled with water, and the steam being admitted, the agitator was set in motion. The water, with the clay which this operation caused to be suspended in it, was afterwards drawn off by a faucet, placed a little above the bottom of the vessel for that purpose. It was then caused to pass through fine wire gauzes into the engine. This process filtered the clay water, and consequently rendered it more fit for the purposes for which it was required.

The operation of causing the clay to unite with the fibre in sufficient quantity was performed by mixing it with starch, or by proper and sufficient sizing. The clay was mixed with the pulp before the size, but was previously boiled with starch or other suitable material.

English China Clay Characteristics

The plasticity and retentive powers of China Clay are important. A clay with a smooth velvety feel when moistened and rubbed between the fingers or placed on the tongue, as some samplers do, is what is wanted. The retentive powers of clay may be judged by making up a 50 per cent. solution and allowing it to stand for half an hour in a glass cylinder and noting to what depth the clay will settle. Do this with a similar test on a sample of a known clay, for comparison. A good grade of clay should not have more than two per cent. grit, either by the 200-mesh test or by the flotation test.

American Paper Expert's Preference

Discussing the relative merits of English and American clays used in paper-making, Mr. Ralph B. Roe, of Boston, U.S.A., a member of the Technical Association of the Pulp and Paper Industry, has summed up the chief features of English China Clay which distinguish it from American domestic clays for paper-making purposes. In the course of a paper to his Association a few years ago, he said that the prejudice against domestic clays was to a large extent founded on the excessive amount of grit which was shown in the earlier grades. The evil effect of grit in clay was, he said, easily demonstrated, and any feeling engendered against a clay on that ground was quite justified. For coating purposes, the view seemed to be quite universally held that domestic clay did not fulfil the requirements of the trade. Excepting colour, which must be high, there were certain rather obscure characteristics which rendered the English clay peculiarly well fitted for the purpose. It was probable, added Mr. Roe, that these desirable qualities were intimately connected with the plasticity, and although considerable research work had been carried out on the subject of American paper-making clays, the matter seemed to call for further work with special reference to the coating problem.

The obscure characteristics of English China Clay alluded to by Mr. Roe have baffled other experts, and account for its being acknowledged as the criterion by paper-makers of what a paper clay should be. This view of the unique character of English China Clay for paper-making is endorsed by British paper-makers as well as by European paper-makers, the latter, like those of the United States, importing large quantities because their own domestic kaolins are not so well adapted for the purpose, especially in news-print, magazine, and book papers, in which clearness of type and clear-cut impressions from illustration blocks are a desideratum.

Opening Up New Clay Areas

Commercial Advantages of New Halwill-Torrington Railway

THE contemplated opening for traffic at the end of this month of the Halwill-Torrington Railway is expected to have an important bearing on the industrial development of North Devon. The scheme is of particular interest to readers of THE CHINA CLAY REVIEW because it will supply much-needed transport facilities for large new tracts of China Clay and Ball Clay land which are being opened up.

The line, with a length of 20½ miles, connects the North of Devon with the North of Cornwall, and will transform a great tract of Devon into a business, industrial and residential area. The original plans provided for a direct communication between Halwill and Torrington, but a deviation was made to bring the railway nearer to Hatherleigh, where a station has been built about a mile from the town. Halwill, which will be the intersecting point of two railways running roughly east and west from Oakhampton to Bude, and north and south from North Devon to Launceston and Wadebridge, will become one of the largest and most important junctions on a single line in the United Kingdom. Some idea of the immense benefits to be derived—and, incidently, the disadvantages from which the locality has suffered so long—can be gathered from two instances. From Torrington to Bude by rail via Barnstaple, Yeoford and Okehampton is now 70 miles; by the Halwill route the journey is reduced to 30 miles. Plymouth and Torrington are now 87 miles by rail; the new route will measure 55 miles.

The Scheme

The scheme was undertaken by the North Devon and Cornwall Junction Railway Company, advised by Colonel H. F. Stephens of Tonbridge, the engineer of many similar works, including the Calstock and Callington Railway. Until February last it was in the hands of a firm of contractors, but it was then relinquished by them and has since been operated by the company under the supervision of a resident representative of the engineer. When the first sod was cut by Mr. Arthur Neal, of the Ministry of Transport, on June 30, 1922, it was expected that the constructional work would be completed in about 20 months, but the period has been extended to very nearly three years, owing mainly to the exceptionally wet summer seasons of 1923 and 1924, and to the type of labour employed under the conditions imposed by the Ministry in consideration of the financial assistance given. It is hoped the railway will be sufficiently completed by the end of this month for goods traffic to be started, and it is possible that passenger traffic will follow shortly afterwards. It will be taken over and worked by the Southern Railway, and while nothing definite is known regarding the service, it is thought there will be four or five passenger trains run each way daily, the journey occupying just over one hour.

On the line there are stations at Petrockstow—near the residence of Lord Clinton, a director of the Southern Railway, and who has most generously assisted in the promotion of the local scheme—Hatherleigh and Hole, which will serve Black Torrington, Sheepwash and Highhampton, with halts at Dunsbear and Meeth.

Clay Works Connected

The principal engineering feature of the work is the new steel viaduct at Torrington, 700 feet long and 40 feet high, by the side of the old artistic timber structure which has served its purpose for 50 years as part of the North Devon (Marland) Clay Co.'s 7-mile light railway connecting the works with Torrington Station. The fact that the new track has had to be constructed on top of the old narrow gauge without interfering with its working, proved a difficulty which has caused delay, but the old line will be dismantled when the new one is opened. Two more old wooden viaducts on the clay works line have been replaced by earth banks. There are various road and river bridges, one of which crosses the river Torridge, and nine public road level crossings. It has not been necessary to make any tunnels.

Passing as it does over high ground, the railway in its winding course affords many picturesque views of the surrounding country. It crosses two ranges of hills of about 400 feet, and finally ends at Halwill, 612 ft. above sea-level. Roughly from Torrington it runs up to 400 ft. in four miles, then drops down into the clay lands to about 200 ft., rises again to Meeth about 330 ft., falls to the Torridge, which is spanned at about 200 ft., and then climbs up to Halwill.

The scheme has occupied public attention for a good many years. Really the lack of railway facilities in the district has been noticed since 1847, and on several occasions applications were made to Parliament and other authorities for concessions with a view to removing the defect. Powers were granted but it was found impossible to raise the necessary capital. The present scheme, however, is the most economical that has been brought forward, and the estimated cost when the project was first laid before the Commissioners in 1910 was only £133,053, a figure which is interesting in relation to the sum actually expended.

Financing the Scheme

Suspended during the war, the scheme was afterwards revived. Approval being given to it by Lord St. David's Committee, which had to consider the means of alleviating unemployment in the country, the Government made a free grant of £80,000 towards the scheme. With this undertaking the promoters approached the local authorities and received valuable assistance: Devon County Council voting £40,000, Torrington Rural Council £12,000, Okehampton £6,000, and Holsworthy £5,000—a total of £63,000. Financial contributions were also forthcoming from local industrial concerns, including the North Devon Clay Co. £9,000, landowners £10,000, and other subscriptions £1,000. On these figures the Ministry was asked for a grant of £180,000, upon which the promoters were prepared to make an immediate start, raising a capital of £300,000.

Colonel Stephens, the engineer and managing director, interviewed Mr. Arthur Neal, with the result that the Minister made a definite offer that the Government would grant £125,000 towards the construction on certain conditions and under certain guarantees. The chief condition was that the remaining half or more of the money should be provided by subscriptions other than the Government grant, which was to be invested in the railway company in debentures, preference shares and ordinary stock in three equal parts. The Government also reserved the right to appoint one director on the board, approve the appointment of auditors and accountants, be satisfied as to the means of working the railway, require the clay companies in the area to give some form of guarantee of traffic on the new line, and that the sale price of the land purchased must be invested in the company in fully-paid-up shares. Those conditions were all met, and as the Government set a short time limit on their offer so well was the scheme supported that at the end of the specified period the promoters were able to inform the Ministry that their conditions had been complied with.

Industrial Advantages

The line passes through agricultural country, which, from an engineering point of view has rendered construction easy and comparatively inexpensive. At and in the neighbourhood of Marland are extensive China and Ball Clay workings, and there are similar deposits of clay in other parts of the district which will be served by the railway. The chief industry forms a valuable source of traffic capable of considerable development, and there have been inquiries from manufacturing firms for sites for the establishment of other works. The railway serves an area of approximately 100 square miles, embracing 17 parishes, with a population of over 13,000.

The works are of such a nature as to enable a large percentage of labour to be employed. Practically the whole of it has been drawn from the areas of unemployment in the county, and arrangements were made for the erection of hutments to provide accommodation for the imported labour, which could not be housed in the villages. On an average fully 300 men have been engaged for nearly three years, and over 80 per cent. of the number were drawn from unemployed. Throughout the line there have been laid country oak sleepers cut from the woods in the neighbourhood, seasoned and wrought locally, and this work has given employment to a considerable number of workmen.

The local and industrial advantages which must result from

the opening of the railway are incontestable. One of its most important aspects is the development of the clay industry. The North Devon Company, in shipping clay for America, via Fowey, have to go to Torrington over their own line, re-truck on to the Southern, and despatch to Cornwall via Lydford and Yeoford. A recent addition to the industry has been made by the opening of the works of the Meeth Clay Co., which are skirted by the new line, and a considerable mineral traffic can confidently be expected from this source also.

Waterway to Potteries District

Plans to Cheapen Transport

READERS of THE CHINA CLAY TRADE REVIEW will be interested in the movement in the Midlands to improve the facilities for water transport, especially as it embraces the provision of better facilities for the transport of China and Ball Clays from ports on the Mersey whence they are imported inland to the Potteries and other industrial centres.

The subject was discussed at a meeting of the National Council of the Pottery Industry at Stoke-on-Trent last month, when Colonel J. A. Saner, engineer and general manager of the Weaver Navigation Trustees, who control the canals in the neighbourhood of the Potteries, spoke of the need of a better system of waterways. He said now that the Birmingham Corporation was making a serious effort to get something done towards making further use of the waterways in their area, it should be the duty of an industrial district like the Staffordshire potteries to take an interest in any suggestion which had for its object the unification of the means of transport by water, and aiming at the solution of the great problem of how to convey materials between the Midlands and the seaboard with the least possible economic loss. The fact that the railway companies were strongly opposed to the improvement of our existing waterways was one of the strongest arguments in favour of the reconstruction of our canals. The railway companies feared that their traffic would be damaged by the provision of improved water transport. But this did not prove to be the case in the construction of the Manchester Ship Canal, for although the construction of this improved waterway had enabled certain goods to be carried to and from Manchester at less cost than formerly, the ultimate result was an extension of traffic and trade, which not only benefited Manchester, but benefited the railway companies connected therewith. And likewise, it was only reasonable to assume that if the canal between Stoke-on-Trent or Birmingham and the estuary, were so improved as to enable barges to navigate to Liverpool or Manchester, similar results would accrue.

How Water Transport Reduces Charges

As an indication of how the charges for transporting goods were reduced by the provision of adequate waterways, the speaker cited the case, before the war, of conveying coal in special barges on the Aire and Calder Canal between Knottingley and Goole. This, he said, was about $\frac{1}{20}$th of a penny per ton per mile, and many millions of tons were sent. This figure gave some idea as to the reduction in costs that might be looked for. He could safely prophesy that there would be a reduction of from 30 to 40 per cent. in the existing charges of conveying a ton of goods between Stoke-on-Trent to Weston Point or Runcorn, which at the present time ran out at about 28s.; if the new suggested waterway from Birmingham to the Mersey became a fact, it was possible that coal and other minerals could be delivered from Stoke-on-Trent to ship at Liverpool or Manchester or at the Weaver estuary at prices that would compare favourably with the cost from Lancashire.

Link with Mersey Ports

Describing the actual scheme now under consideration for the improvement of the canals between Birmingham and Liverpool, the speaker said that the idea was to commence in Birmingham itself, and improve the main line of the Birmingham canal system between there and Wolverhampton, thus giving the adjacent towns, which comprised what was at one time known as the "Black country," access to the waterways. This could be done at a very reasonable cost, but there was a difficulty in overcoming the difference of height at Wolverhampton, which amounted to about 130 ft. In the scheme this was provided for by means of two lifts, and, although the work was special and costly, it was not unreasonably so, as it avoided the delay and waste of water of the twenty-one narrow locks now there. After this, the line followed the Stafford and Worcester Canal as far as Berkswich, near Stafford, when there was a new length cutting off the sharp corner of Haywood Junction and rejoining the old route just below Aston-by-Stone, so saving about $5\frac{1}{2}$ miles in length of route. From Aston the old route was followed, with only short diversions as far as Middlewich, when again there was a new length of about $4\frac{1}{2}$ miles to make direct connection with the River Weaver.

The question of dealing with the Harecastle Tunnel had been considered, and provision made for either improving the existing tunnel or making a diversion, either way being within reasonable limits of cost and present-day tools. The River Weaver navigation required no alteration; it was capable of accommodating barges of 300 to 400 tons burthen, and had sufficient water, staff, and equipment to allow for anything Birmingham and Stoke could send down. The port of Weston Point, where the Weaver now joined the Manchester Ship Canal, was well provided with wharves, cranes, warehouses and other plant, where at present there were thousands of tons of flints and China stone lying on the wharves, and China Clay stored in the warehouses awaiting orders from merchants. The size of the barge to be provided for was one of about 100 tons displacement when loaded down to 5 ft. draught. Such barges could navigate to Liverpool without transshipment, and as the lifts and locks would pass not less than two at a time, the leading barge could be self-propelled and tow two or three in train. The increased speed of travel had been obtained by the substitution of 24 lifts for the present 92 locks, and by the adoption of these lifts the trouble with regard to the insufficiency of water supply had been overcome.

Importance to Potteries Supplies and Products

The speaker said that he commended the scheme most strongly to the support of all interested in the welfare of the Potteries district. The total cost was estimated at from $6\frac{1}{2}$ to 7 million pounds, and it would require $1\frac{1}{2}$ to 2 million tons using it per annum, in addition to present traffic, to make it a sound investment for the shareholders. Neither of these figures appeared excessive, and, although he did not say there would not be a dividend on the capital, even though there should never be any divisible profits, it would pay the merchants interested to subscribe heavily, in view of the saving that would be obtained in the cost of transport. Personally, he had no doubt that no one would ever regret taking a share in such an undertaking.

Colonel Saner said it was certainly not desirable that the railway companies should be the controlling element in the new Waterway Board. Unless the railway companies entirely changed their present policy, the canals ought to be taken out of their hands altogether. The scheme could not be carried out without legislation, and the proposal was either compulsory purchase of the existing canals from the railway companies, or the forming of an authority, such as the Port of London Authority, which took over the old London Docks and grouped them together. It was also suggested that the authority should be one very similar to the Weaver Navigation, which was not a company and did not pay any dividend; any profit, after certain reserve funds had been provided, went to the relief of the rates of Cheshire. During 200 years the rates of Cheshire had been relieved in that way to the extent of nearly £1,200,000.

Mr. Shelley, in proposing a vote of thanks to Colonel Saner, reminded the audience that the pottery district had for some generations been crippled for want of a better waterway. The present canal was constructed 160 years ago, and had been improved very little since. Cheap water transport would have made an enormous difference to the heavy trades of the district, apart altogether from the pottery trade. In France enormous sums of money had been spent in making canals, particularly in the industrial districts in the North. The Germans, too, had long navigable rivers, but they had had to spend large sums of money in making them navigable and in constructing canals. The German manufacturers were able to send goods about 500 miles by water for about as much as it cost the Staffordshire Potteries to send their goods about 40 miles to Winsford or Runcorn. An up-to-date canal would be a very great asset to the pottery trade.

Utilisation of China Clay Sand

By China Clay "Captain"

I HAVE written about sand in some of my former articles, how it is dealt with, contrasting the old laborious way with present-day labour-saving methods, and reviewing the several stages from the days of "landing sand" up to the modern "patent" pit. As everyone knows, if they have only a slight acquaintance with the China Clay area, "sand" is the quartz of the decomposed granite which is waste when producing China Clay, and as quartz to felspar is roughly 4 to 1 in the virgin clay, it means that to produce 1,000 tons of clay, roughly 4,000 tons of sand have to be disposed of. When this has to be hauled, say, 400 ft. vertical from bottom of clay mine to top of sand-bank in engineering units it works out as 1,600,000 foot-tons of work, nett, leaving friction and the weight of rope and skipwagon out of the calculation.

This work is done on *sand* alone, to say nothing of "stent," mica, overburthen, pumping, conditioning, drying, loading, rents, dues, etc.

Even with the most economical up-to-date machinery, this forms one of the large items on the bill of costs of a clay-work, and if the China Clay merchants were not such enterprising, ingenious, capable managers, and the clayworkers such splendid workmen, it would be impossible to produce clay at the very moderate price per ton it is to-day. Instead of gradually winning its way back to its pre-war tonnage in the markets of the world, it would very likely have been ousted ere now by foreign competition.

Uses of Sand

But to return to sand. While a waste from the producers' standpoint, yet it is useful for some things. It makes a capital finishing coat for garden paths after it sets, just a bit sticky immediately after the first shower of rain, but soon wears in, and makes a good road, its pure white making a pleasant contrast to the black or red soils of the garden bed. Then, mixed with putty lime in proper proportion, it makes good sound tempered mortar for building with any kind of building stone. As a backing for clay-tanks or clay-pits, if well "watered in," it cannot be beaten. It is also the principal ingredient in making cement blocks (as reported in last month's issue). When used for building concrete walls laying between boards, if the layers are not put on too quickly, but allowed to set for a few days, according to weather, I have it on the authority of a foreman mason that a mixture of 10 of sand to 1 of cement would be quite strong enough for building *one*-storey houses such as bungalows, garages, stores, or boundary walls.

Then, again, at the brickworks, mixed in the pugmill with waste clay and mica, it makes excellent building bricks, tiles for drying kilns, boiler blocks, etc. Selected sand from some of the clayworks makes excellent firebricks for resisting intense heat.

So when we think of the different uses to which it is put it is not quite right to call it altogether a waste product. No doubt there are other uses which I have not mentioned. Indeed, I recall that I once helped to send 500 tons of sand to Fowey to ballast a boat, and some football pitches are marked out very distinctively with sand. But still, all these uses do not take one-thousandth part of the sand produced, and if anybody wants sand they could probably have it in any quantities from 10 to 1,000 tons at, say, 2s. 6d. per ton.

Before the days of water bailiffs, sand as well as mica was washed away down the rivers with the storm or surplus water. More than once in sinking trial pits, cutting leats, etc., my men have come across or cut through layers of sand in what are now cultivated fields. While at Ruanlanihorne during last summer, talking to the oldest inhabitant (an octogenarian), he related that just opposite the river wharf, what is now a nice plot of ground about an acre in area and growing splendid grass, when he was a lad was under water every high tide, so the "waste" from the clay district has done somebody a "bit of good."

There must be scores, if not hundreds, of acres adjoining the rivers that formerly were little better than swamps which are now good grazing lands. We hear much about silting up the rivers, but very little about the advantages of letting sand and mica go down stream. Perhaps some enterprising landowner with land adjoining the rivers will take the tip and employ a dredger to keep the stream navigable and with the dredgings make cultivated fields out of the mud-banks, and verify the old saying that "the ditch will make the hedge."

The Late Mr. James Perry

A China Clay Trade Romance

THE success of Mr. James Perry (to whose death we briefly referred in our last issue) in the China Clay trade was one of the romances of the industry, for he was over 40 before he started to devote all his energies to it. Previously he had been engaged in a totally different sphere.

One who knew him writes: "The passing of Mr. James Perry came as a great shock to his intimate friends and to a wider circle of friends who knew and came into contact with him in various activities in the St. Austell district. He was a self-made man, and from humble beginnings, when the facilities for acquiring knowledge were very meagre, he rose by dint of constant application to work to a position of prominence in the business life of St. Austell. Starting his business career in the grocery trade, he later went into the catering trade, and carried on a prosperous business at the Temperance Hotel in Menacuddle Street, from which he retired about twenty years ago to devote himself to the China Clay business, in which he had previously secured a financial interest. He came to it handicapped by the absence of the lifelong experience which most of his contemporaries possessed, and, what was more serious, he embarked upon an undertaking that was said to be doomed to failure. This undertaking was the well-known Burthy Works.

A Hard Struggle

"Taking it over when its fortunes were at their lowest, Mr. Perry set himself the formidable task of making it a success. He told me on one occasion of the almost insuperable difficulties with which he was confronted in those days, of the large amount of capital that Burthy swallowed up, and the prospect of failure with which he and his co-adventurers were faced before the tide turned. When less persistent men would have withdrawn he persevered, and was eventually rewarded by seeing Burthy develop into one of the best clay works in the St. Austell district. That venture of his may be said to have laid the foundations of his fortunes in the China Clay industry, for the reputation he thus made led to his being able to inspire confidence in his good judgment and business acumen and to develop other China Clay properties. These turned out well for the shareholders who invested capital in his undertakings. The secret of his business success was hard work, patience, perseverance, and persistence, an example to the present generation of the eventual triumph of those qualities."

With all his business activities Mr. Perry found time for public services. He was a member of the District Education Committee, a Governor of the St. Austell County School, and for twenty years a member of the St. Austell Urban Council and twice chairman. He took a keen interest and was an active supporter of the St. Austell Wesleyan Church, in which he had held several offices. His two sons, Mr. S. B. Perry and Mr. A. J. Perry, have been associated with their father in the China Clay industry, and have succeeded to his offices.

Mr. Perry married twice, his former wife being a Miss S. Pedlar, of Bojea Farm, near St. Austell, and in September, 1921, he married Miss E. Coles, the eldest daughter of the late Mr. Joseph L. Coles. Deceased leaves a widow, a daughter (wife of Mr. H. L. Lodge, B.Sc.), and two sons, Messrs. S. B. and A. J. Perry.

At the funeral on Easter Sunday there was a very large representation of the religious, civic, and commercial interests of the district, a tribute to the high estimation in which Mr. Perry was held.

St. Austell Urban District Council was represented by the Chairman (Mr. T. H. Williams), Councillors H. Hodge, J.P., T. J. Smith, J. W. Hoskin, M. H. Vivian, F. W. Mutton, A. J. Bragg, S. Mitchell, J.P., T. Inch, R. H. Luke, A. Rowett, Jas. Stephens, Dr. A. Shaw (M.O.H.), Mr. G. B. Dobell (Clerk), Mr. E. D. Groves (Surveyor), and Messrs. H. S. Hancock, W. J. Nicholls, W. Dunn, H. Rowse, N. F. Bellamy and J. Mules, members of the old Council. The China Clay industry was represented by Mr. J. W. Higman, J.P. (J. W.

Higman and Co.), Mr. John Lovering, J.P., Mr. F. R. Lovering, Mr. J. S. Lovering (J. Lovering and Co.), Mr. M. F. Hitchins (English China Clays, Ltd.), Mr. J. Hooper (Anchor China Clay Co.), Mr. H. Rowe (Manchester China Clay Co.), Mr. A. S. Liddicoat (Paper Makers' Importing Co.), Capt. R. M. Richards (Cornish Kaolin China Clay Co., Ltd.), Mr. J. Morton (Hensbarrow United China Clay Co.), Mr. W. Wedlake (South Carclaze China Clay Co.), Captain J. Merrifield, Messrs. E. H. Penrose, H. D. Kenyon, W. Phillips (representing the directorate of the various China Clay companies with which the late Mr. Perry was associated), Mr. S. Benson (China Clay Producers, Ltd.), Captain J. Tonkin and Mr. D. Warne (Carbis China Clay and Brick Works, Ltd.), Captain Baglow (Burthy China Clay Works), Messrs. D. Phillips and A. Boundy (Burthy Works), Captain Tom Dyer (Trethowel China Clay Works), Mr. S. J. Dyer (Roseveare and Imperial Goonbarrow China Clay Works), Messrs. J. G. Penna and J. Hore (Ruthern), and Mr. P. M. Coode (China Stone Association).

English China Clays, Ltd.

Mr. R. Martin on the Old Association

THE general meeting of English China Clays, Ltd., of St. Austell, was held at the Institute of Chartered Accountants, Moorgate, London, on April 26. Mr. R. Martin, Chairman and Managing Director of the Company, presided. Two notable absentees from the meeting were Mr. T. Medland Stocker (joint managing director), who is travelling abroad for the benefit of his health, and of Lieutenant-Colonel A. O. Evans (a director), whose recent death is much regretted.

Moving the adoption of the annual report and balance sheet, Mr. Martin made sympathetic references to the recent death of Lieutenant-Colonel A. O. Evans, and a vote of condolence was passed to his widow and family, the shareholders standing for a moment in silence. Dealing with the report, Mr. Martin said that taking the circumstances into account the results for the year would be considered satisfactory. The net profit for the year was £85,879 17s. 4d., as compared with £91,918 10s. 10d. for the preceding year, to which had to be added £13,987 8s. 10d. brought forward from 1923, making in all £99,867 6s. 2d. Out of this sum there had to be deducted dividend on the preference shares for the half-year to June 30, 1924, £10,603 12s. 8d., and dividend on preference shares for the half-year to December 31, 1924, £10,614 14s. 2d., and an interim dividend of 2 per cent. on ordinary shares amounting to £25,380, making a total in all of £46,598 6s. 10d., leaving a balance in hand of £53,268 19s. 4d., which the directors recommend should be applied as follows :—Final dividend of 2½ per cent., making 4½ per cent. for the year on the ordinary shares, £31,725 ; transfer to general reserve £10,000, leaving a balance to carry forward of £11,543 19s. 4d.

The Association

" Last year," said Mr. Martin, " I had to refer to the very uncertain life of the Associated China Clays, Ltd., an association which had been of inestimable benefit not only to the directors and shareholders but to the employees of the firm. The persistent failure of a certain section of the smaller firms to abide by the agreement finally brought matters to a climax, and in September last it was decided to wind up the Association, much to our regret. This has led to a reduction in prices varying from a small drop in best quality clays to larger reductions on medium and lower grade clays. As English China Clays, Ltd., mainly produces high-grade clays, we have not been so hardly hit as some other companies, but the average profit will be materially affected as long as these low prices remain. It is extremely galling and utterly foolish that the prosperity which 1925 seemed to hold out to us should be wilfully destroyed by selfishness and a lack of good will on the part of those whose aim should have been to support the Association. One can only hope that material considerations backed up by hard facts will prove to them that only by pulling together and by complete union can the trade hope to improve its position.

" The demand for China Clay shows a very welcome expansion, both for home consumption and for export, notwithstanding the fact that the Russian and Central European markets are still comparatively negligible, and if the prices had remained stable throughout the whole of the period the result of the year's working would have been materially better. Exports last year were up by 60,000 tons on the previous year, while the total trade of the first three months of 1925 shows an actual increase of 50,000 tons over the corresponding period last year. Home consumption, though it has improved, has not shown the same increase owing to the depressed state of the Lancashire cotton industry and the Staffordshire potteries."

Plant Improvements

With regard to the improvements carried out at the works, Mr. Martin stated that the dry kiln at Melbur had been expanded by 100 ft., and an additional drying shed erected. New centrifugal pumps had been installed at Cholwickton, and the three 250 h.p. gas engines which had been installed at Lee Moor power station had made that the largest and most up-to-date power station in the clay area. Good progress was also being made with the new power station at Dorothy. New turbines were being purchased to make full use of the water power in winter at some of the mills, so that the stores of clay could be laid in and thus obviate periods of idleness in the summer time. All this expenditure was part of the settled policy of the company to keep the works in the best state of efficiency in preparation for the time when the world's demand would equal, and perhaps exceed, the pre-war figure.

Mr. Walter Sessions seconded the report. The accounts, he said, were very satisfactory in view of the conditions under which the trade had to work last year. " When all the producers and royalty owners can come to some agreement to unify their interests the results to all concerned with the industry will be very much more beneficial," he said.

The report was adopted, and a final dividend of 2½ per cent., making, with 2 per cent. interim dividend, a dividend of 4½ per cent. for the year, was declared.

Mr. H. Stocker and the Hon. M. B. Parker, the retiring directors, were unanimously re-elected.

The Clay Convention

EVERYTHING points to the Clay Convention, to be held at Buxton from May 19 to 23, being a pronounced success. Over 200 members of different associations in the industry have expressed their intention of being present, including the following :—

Institute of Clayworkers, Dorset and Devon Stoneware Pipe Makers' Association, Terra-Cotta Association, Potters' Association, Ceramic Society, Society of Glass Technology, Refractories Association and the British Silica Association.

The following are the arrangements made to date :—

MAY 19—TUESDAY. Meetings of Ceramic Society, 10 o'clock, 10.30 and 2.30. Dinner. MAY 20.—WEDNESDAY. Institute of Clayworkers. Executive, 10 a.m. Annual meeting, 10.30 a.m. Refractories Association, 11.15 a.m. National Building Brick Federation. Executive, 11.15 a.m. Annual general meeting, 12 o'clock. E.N.C.C.I., Board meeting, 11 a.m. General meeting, 12 o'clock. 2.15 p.m., excursion to Chatsworth and Haddon Hall, etc. 8.30 p.m., reception by the president of the Convention, Mr. Herbert Wragg, M.P. MAY 21.—THURSDAY. South-Eastern Federation, 9.30 a.m. Enamel Association, 9.45 a.m. National Tile Association, 10.30 a.m. Terra-Cotta Association, 11 a.m. National meeting of Firebrick Makers, 12 o'clock. 2.45 p.m., general conference. 6.45 for 7 o'clock, Convention dinner. MAY 22.—FRIDAY. Excursions, etc.

It should be distinctly understood that *all* clayworkers, whether members of the association or not, are cordially invited to attend the proceedings.

High Honour for China Clay Merchant

THE many freemason friends of Mr. J. W. Higman offer hearty congratulations to him on the high honour that has been conferred upon him by his appointment to the past rank of standard bearer in the Grand Chapter of the Royal Arch Freemasons of England. Mr. Higman is the oldest past master of the Peace and Harmony Lodge St. Austell Freemasons and a past " T " of the Province of Cornwall.

China Clay Notes and News

West Cornwall Port's Clay Shipment

Though never a port for the shipment of China Clay on a large scale, Porthleven last month shipped its first cargo of China Clay since 1914. It was a cargo of 120 tons by the Wheal Grey Co., from Breage.

Honour for China Clay Manager

At the first meeting of the new St. Austell Board of Guardians Mr. Richard Hooper, one of the oldest members of the Board in point of membership, was elected vice-chairman. ' He has previously had the opportunity of holding the post, but had declined it. Mr. Hooper is well-known in China Clay circles as the works manager for H. D. Pochin and Co., Ltd.

Loss to Cornish Mining

Cornish mining has sustained a severe loss by the death of Mr. Oliver Wethered, who died at Claygate, Surrey, on April 21, at the age of 64. Mr. Wethered's interests were mainly associated with hard mineral mining. He was responsible for the introduction of many thousands of pounds of capital for tin mining, especially in connection with Dolcoath, of which he was chairman. As a director of Tehidy Minerals, Ltd., he was associated with the China Clay industry.

Fowey Harriers Mastership

At a meeting of Fowey Harriers' supporters at St. Austell last month, the secretary (Mr. W. Treffry) reported that replies received from gentlemen in respect of the post of a new Master in the place of Mr. J. de C. Treffry, resigned, were disappointing. He was, however, able to announce that Lady Vivian of Glynn, Bodmin, and Miss Martyn, Carthew, St. Austell, had, to save the situation, offered to become joint Masters for the coming season. Lady Vivian is the wife of Lord Vivian, who owns clay lands in the Bodmin district, and Miss Martyn is the proprietor of China Clay lands in the St. Austell district, where some of John Lovering and Co.'s works are located.

Link with the Past Broken

A link with the old pioneers of the China Clay industry has been broken by the death, which occurred at Poltair, St. Austell, on April 19, of Mrs. Hart Nicholls, widow of the late Mr. Hart Nicholls, of Hallaze, at the age of 79. Her husband was one of the Nicholls family who were among the pioneers of the China Clay industry, Mr. Nicholls having been prominently associated with North Goonbarrow China Clay works, of which his son, Mr. Hart Nicholls, is now managing director. Mrs. Nicholls was of a benevolent disposition and was always ready to help deserving causes. She leaves two sons—Mr. Hart Nicholls and Mr. Tom Nicholls—and two daughters—Mrs. George Lotcho and Miss Nicholls.

China Clay Merchant on Cornish Books

In an interesting paper before the St. Austell Rotary Club on May 6, Mr. Harold Rose (who is a partner in the China Clay firm of North and Rose) dealt with Cornish books. Referring to the books of Sir Arthur Quiller Couch, Cornwall's own literateur whose home is at Fowey, Mr. Rose spoke of the humour of " Troy Town," Fowey's nickname, but remarked that only those living in and around Fowey at the time the book was published could properly appreciate its piquant flavour, so many of the characters having their prototypes in the ancient town of Fowey.

Giving instances of " Q's " humour, Mr. Rose made reference to the author's amusing dissertation on " The first Parish Meeting " when local self-government came into being at Fowey. The Troyans were very annoyed that the Act only allowed them eleven Parish Councillors, seeing that the Troyans never had less than 65 members on their Regatta Committee and believed local self-government to be at least as important as a regatta. To mark their sense of the iniquity of the thing 72 nomination papers were handed in for the eleven places. To get over the veto against the meeting being held on licensed premises, the Councillors ordered half-a-dozen trays from the " King of Prussia," while the vicar boiled his kettle on the ante-room fire.

Cement and Clay Sand Concrete

At St. Austell Rotary Club luncheon recently, Mr. Thomas Warne, in an address on Portland cement, said that the name Portland was given to it, not because that was its place of origin, but because when hardened it resembled the famous Portland stone. The materials used in the manufacture of Portland cement were lime or chalk and clay, which, after being mixed in slurry mixers, were calcined in rotary kilns and ground ready for use.

Mr. Warne went on to say that in the district they had a very useful aggregate for concrete in China Clay sand because of the tenacity with which the particles clung together by the use of Portland cement. A mixture of six of sand to one of cement made a very durable concrete block, which would stand a lot of knocking about. A danger to guard against in the use of clay sand was Mica Clay, which was very harmful to the setting and hardening qualities of the concrete which contained it and affected its durability.

Par Harbour Development

Operations have just been commenced at Par Harbour for deepening the dock to make it navigable for bigger ships to take cargoes of China Clay and to enable all ships using the harbour to do so with greater freedom. The owner (Colonel Edward Treffry) has secured the services of a dredger belonging to the Fowey Harbour Commissioners, which has been working since April 30. The harbour, both inside and outside the mouth, is being dredged, the entrance having already been made several feet deeper, and something like 150 tons of debris has been taken out. With six men employed the dredger can deal with half a ton per minute. The harbour has been a handicap to shipping owing to the narrowness of the channel. Recently shipping at Par has been showing progress, and when the present dredging scheme is complete there is a prospect of its being greatly increased. Several China Clay firms have adjacent kilns, and for these Par Harbour is very convenient.

Growth of St. Austell and its Trade

To mark the operation of the new urban area of St. Austell, which increases the acreage from 196 to 1,134, and the population from 3,245 to nearly 10,000, Mr. T. H. Williams, the new Chairman, who has recently served two years in a similar capacity on the old Council, entertained to dinner a large company. The China Clay industry was represented by Messrs. J. W. Higman, J.P., Henry Stocker, W. T. Lovering, F. Parkyn, S. J. Dyer and E. J. Hancock, amongst other guests being the Lord Lieutenant of the County (Mr. J. C. Williams), Sir Arthur Carkeek, vice-chairman of the County Council, Colonels Bressey and Stallard, of the Ministry of Transport, and Alderman A. S. Liddicoat and F. W. Jenkin (Chairman of the Rural Council), and Mr. R. H. Luke (Chairman of the Parish Council).

Responding to the toast, " The town and trade of St. Austell," Mr. H. Stocker said that the prosperity of the town was bound up to a great extent with the China Clay trade. Although at the present time it was more or less under a cloud they were all hoping for better things for the future.

Mr. A. E. Gaved, also responding, said that he had been associated with the commerce of the district for something like 56 years. Few in the room could go back further than that, when the trade of the town was dependent upon the tin and copper mines in the district, there having been ten of them within a radius of five miles, as well as four engineering works and foundries. Since then the China Clay trade had grown. He could remember when the wages of the China Clay workers were only 11s. per week. By the courtesy of the stationmaster (Mr. Davey) he had been furnished with figures showing how the trade at the station had increased in twenty years. There had been an enormous increase in passenger traffic, both on the railway and on the motors. Comparative figures of other traffic showed that in 1904 the quantity of China Clay despatched from St. Austell was 39,857 tons, in 1924, 103,755 tons. Coal and coke traffic had risen from 7,700 tons in 1904 to 29,000 tons in 1924. He did not think they needed much better evidence of their prosperity than those figures showed.

Shipping and Export News of the Month

We give below the latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—April, 1925

Arrival Date	Name	Sailing Date	Destination
April 1,	S.S. *Gouwestroom*	April 4,	Amsterdam
April 1,	S.S. *Isabelletta*	April 4,	Larne
April 1,	S.S. *Mistley*	April 6,	Grimsby
April 1,	S.S. *Shoreham*	April 6,	Brussels
April 2,	M.V. *Frida Both*	April 6,	Harburg
April 2,	S.S. *Moss Rose*	April 2,	Charlestown
April 4,	S.S. *Mellanear*	April 8,	Antwerp
April 4,	S.S. *Robbrix*	April 6,	Gravesend
April 4,	*Martin Nisson*	April 6,	Helsingborg
April 5,	S.S. *Abercraig*	April 11,	Leith
April 6,	S.S. *Agga*	April 6,	Montreal
April 7,	*Hertha*	April 9,	Leith
April 7,	*Elisabeth Eff*	April 16,	Drammen
April 7,	*Harwarden Castle*	April 8,	Par
April 7,	S.S. *Cornish Merchant*	April 14,	Ridham
April 7,	S.S. *T. P. Tilling*	April 9,	Runcorn
April 8,	S.S. *Tanny*	April 9,	Penarth
April 8,	S.S. *Glen Mary*	April 17,	Weston Point
April 9,	S.S. *Claretta*	April 14,	Rouen
April 9,	S.S. *Farfield*	April 17,	Grimsby
April 11,	S.S. *Hulmia*	April 17,	Philadelphia
April 11,	S.S. *Florentino*	April 17,	Genoa
April 12,	S.S. *Baron Minto*	April 22,	Philadelphia
April 14,	S.S. *Calcaria*	April 17,	Newlyn
April 14,	S.S. *Gouwestroom*	April 21,	Amsterdam
April 16,	S.S. *Orleigh*	April 16,	Ridham
April 16,	S.S. *Beeston*	April 18,	Birkenhead
April 17,	S.S. *Ebbrix*	April 21,	Antwerp
April 17,	S.S. *Avonville*	April 21,	Preston
April 17,	S.S. *Daisy*	April 21,	Lancaster
April 18,	*R. Passmore*	April 28,	St. Malo
April 18,	S.S. *Ortona*	April 22,	Ridham
April 18,	S.S. *Ferndene*	April 23,	Antwerp
April 18,	S.S. *Southwell*	April 21,	Reval
April 19,	S.S. *Esther*	April 22,	Ridham
April 19,	M.V. *Lynetten*	April 29,	Bo'ness
April 21,	M.V. *Tankar*	May 1	Raumo
April 21,	*Worry Not*	April 21,	Pentewan
April 21,	S.S. *Edern*	April 24,	Birkenhead
April 21,	S.S. *Pickmere*	April 24,	Liverpool
April 21,	*Kate*	April 24,	Pentewan
April 21,	M.V. *Elbnixe*	April 25,	Harburg
April 21,	M.S. *Ostfjeld*	April 24,	Skien
April 22,	S.S. *Brier Rose*	April 23,	Hull
April 23,	S.S. *Hoffnung*	April 28,	Antwerp
April 23,	S.S. *Effie Gray*	April 25,	Grimsby
April 23,	S.S. *Shoreham*	April 24,	Preston
April 23,	S.S. *Barflo*	April 25,	Brussels
April 25,	S.S. *Beeston*	April 29,	Birkenhead
April 25,	S.S. *Treleigh*	April 29,	Runcorn
April 26,	S.S. *Alberta*	April 29,	Gravesend
April 26,	S.S. *Dansborg*	May 2	Portland, Me.
April 27,	S.S. *Clara Monks*	April 30,	Aberdeen
April 27,	S.S. *Falmouth Castle*	April 30,	Runcorn
April 27,	S.S. *Cervantes*	April 29,	Genoa
April 28,	S.S. *Tyne Maru*	*	
April 28,	*Alice Williams*	*	
April 28,	*Rothersand*	*	
April 29,	*Jade*	*	
April 29,	S.S. *Bauta*	*	
April 29,	S.S. *Marena*	May 1	Manchester
April 29,	S.S. *T. P. Tilling*	May 1	Preston
April 29,	M.V. *Earl Cairs*	May 2,	Gravelines
April 30,	*St. Jerno*	*	
April 30,	M.V. *Dietrich Hasseldieck*	May 4,	Raumo
April 30,	S.S. *Adam Smith*	May 4,	Weston Point

* Signifies "In Port."

Charlestown Shipping—April, 1925

Arrivals

Date.	Vessel.	From
April 1	*Waterwitch*	Falmouth
April 2	*Moss Rose*	Dublin
April 3	*Scone*	Torquay
April 7	*Crossbill*	Penryn
April 7	*Neptune*	Mevagissey
April 10	*Doris Thomas*	Barry
April 15	*Alfred Rooker*	Par
April 18	*Bauemaster*	Southampton
April 21	*Paul Arsene*	Plymouth
April 22	*Lady Belle*	Hayle
April 23	*Loch Leven*	Plymouth
April 28	*Greenhithe*	Teignmouth

Sailings

Date.	Vessel.	Destination.
April 6	*Moss Rose*	London
April 7	*Pacific*	Glasgow
April 8	*Waterwitch*	Runcorn
April 8	*Loustic*	Nantes
April 8	*Scone*	Rochester
April 8	*Crossbill*	Rouen
April 10	*Mary Barrow*	London
April 11	*Neptune*	Granton
April 19	*Doris Thomas*	Barrow
April 21	*Alfred Rooker*	London
April 23	*Bauemaster*	Christiansand
April 23	*Lady Belle*	Barrow
April 24	*Paul Arsene*	Boulogne
April 25	*Loch Leven*	London
April 30	*Greenhithe*	London

Par Harbour Shipping—April, 1925

Arrivals

Date.	Vessel.	From
April 1,	S.V. *John Sims*	Falmouth
April 1,	S.V. *Alert*	Truro
April 5,	S.S. *Jolly Frank*	London
April 6,	S.V. *Mary Ann Mandall*	Falmouth
April 7,	S.V. *Hawarden Castle*	Fowey
April 7,	M.V. *Margaret Hobley*	Falmouth
April 7,	M.V. *Kate*	Plymouth
April 8,	S.S. *Walnut*	Cardiff
April 8,	S.S. *Multistone*	Newcastle
April 8,	S.S. *Pine*	Plymouth
April 8,	S.V. *Lord Devon*	Falmouth
April 9,	S.S. *Mia*	Portreath
April 9,	S.V. *Alfred Rooker*	Plymouth
April 10,	S.S. *Magrix*	Hull
April 12,	S.S. *James Tennant*	Goole
April 18,	S.S. *Vilvorde Maritime*	Southampton
April 19,	M.V. *Petite Janine*	Plymouth
April 19,	S.S. *Marena*	Penzance
April 21,	S.V. *Henrietta*	Falmouth
April 22,	S.V. *Scotia*	Plymouth
April 23,	S.S. *Towy*	Jersey
April 24,	M.V. *Irene*	Youghal
April 30,	S.V. *Leading Light*	Mevagissey

Sailings

Date.	Vessel.	Destination.
April 7,	S.V. *Snowflake*	Runcorn
April 7,	S.S. *Jolly Frank*	Pentewan
April 8,	M.V. *Katie*	London
April 8,	S.V. *Naiad*	Antwerp
April 8,	S.V. *Alert*	Weston Point
April 10,	S.V. *Genesta*	Terneuzen
April 10,	S.V. *Wilhelmina*	—
April 10,	S.V. *John Sims*	Runcorn
April 10,	S.S. *Pine*	Weston Point
Arpil 11,	S.S. *Mia*	—
April 11,	S.S. *Multistone*	Gravesend
April 15,	S.S. *Walnut*	Fowey
April 15,	S.V. *Alfred Rooker*	Charlestown
April 15,	S.S. *Magrix*	Teignmouth
April 16,	S.S. *James Tennant*	Bridport
April 20,	M.V. *Kate*	Avonmouth
April 22,	S.S. *Marena*	Preston
April 22,	M.V. *Margaret Hobley*	Weston Point
April 23,	S.V. *Fanny Crossfield*	Liverpool
April 23,	S.V. *Lord Devon*	Gravelines
April 23,	S.S. *Vilvorde Maritime*	Terneuzen
April 24,	M.V. *Petite Janine*	Poole
April 24,	S.S. *Towy*	Penarth
April 25,	S.V. *Henrietta*	Runcorn
April 25,	S.V. *Scotia*	Rochester

Par Harbour Tide Table, May, 1925

(British Summer Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Saturday	16	0.4	0.44	9.9
Sunday	17	1.24	2.2	10.2
Monday	18	2.38	3.12	10.11
Tuesday	19	3.43	4.13	11.8
Wednesday	20	4.38	5.3	12.4
Thursday	21	5.25	5.47	12.7
Friday	22	6.8	6.28	12.8
Saturday	23	6.47	7.4	12.8
Sunday	24	7.23	7.39	12.6
Monday	25	7.55	8.12	12.1
Tuesday	26	8.27	8.45	11.9
Wednesday	27	9.3	9.19	11.0
Thursday	28	9.25	9.55	10.4
Friday	29	10.16	10.38	9.8
Saturday	30	11.2	11.30	9.1
Sunday	31	—	0.1	9.1

E. CLEMENS, Harbour Master.

China Clay Exports for March

RETURN showing the exports of China Clay, the produce or manufacture of the United Kingdom, from the United Kingdom to the countries of destination registered during the month ended March 31, 1925.

COUNTRY OF DESTINATION	China Clay (including Cornish or China Stone) QUANTITY Tons.	VALUE £
Foreign		
Sweden	2,856	6,873
Norway	1,252	1,697
Denmark (including Faröe Islands)	550	1,438
Germany	1,060	2,344
Netherlands	4,627	9,374
Java	104	398
Belgium	4,415	7,338
France	2,360	4,331
Spain	248	671
Italy (including Fiume)	2,065	5,692
Siam	2	10
China (exclusive of Hong Kong, Macao and leased territories)	10	38
United States of America	21,393	40,705
Argentine Republic	76	473
British Possessions		
Irish Free State	—	1
Nigeria (including British Cameroons)	—	14
Transvaal	—	1
British India, *via* :—		
Bombay, *via* Karachi	283	1,130
Other ports	1,434	6,054
Bengal, Assam, Bihar and Orissa	104	412
Australia	83	400
Canada	178	407
Total Foreign Countries and British Possessions	43,100	89,801

April China Clay Deliveries

Considerable Drop from March Figures

FOLLOWING the satisfactory month of March, when a total of 98,598 tons of China Clay, Ball Clay, and China Stone was shipped, there was a heavy drop of 34,658 tons in April, almost wholly accounted for, with the exception of a few tons, by the reduced shipment of China Clay. Fowey alone was responsible for 28,742 tons of the drop, Penzance for 3,000, Par for 1,000, and Charlestown for over 600. The main cause of the fall was the shipping of less tonnage to the U.S.A.

On the four months, the total tonnage of all classes is still 33,100 tons ahead of the corresponding period last year, China Clay being ahead by 37,762 tons.

Details :— Port.	China Clay. Tons.		China Stone. Tons.		Ball Clay. Tons.		Total Tons.	
	1925	1924	1925	1924	1925	1924	1925	1924
Fowey	45,713	60,452	2,395	3,972	1,118	2,627	49,226	67,051
Par	4,040	4,400	793	651	—	—	4,833	5,051
Charlestown	3,646	3,100	—	—	—	—	3,646	3,100
Plymouth	1,248	1,065	10	28	—	—	1,258	1,093
Penzance	330	—	—	—	—	—	330	—
Porthleven	120	—	—	—	—	—	120	—
Falmouth	110	—	—	—	—	—	110	—
Newham	—	243	—	—	—	—	—	243
Looe	—	157	—	—	—	—	—	157
By Rail	4,417	5,894	—	—	—	—	4,417	5,894
Totals	59,624	75,311	3,198	4,651	1,118	2,627	63,940	82,589
March	94,217	74,191	2,526	4,152	1,855	2,297	98,598	80,640
February	66,863	52,244	3,436	1,575	614	1,118	70,913	54,937
January	74,490	56,686	2,506	3,978	3,050	1,567	80,046	62,231
4 months	295,194	258,432	11,666	14,356	6,637	7,609	313,497	280,397

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of* 1908 *provides that every Mortgage or Charge, as described therein, shall be registered within* 21 *days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

BURY PAPER MAKING CO., LTD.—Registered April 24, £400 debentures; charged on properties at Pilsworth, Heap and Bury, also general charge (except uncalled capital). *Nil. July 18, 1924.

JONES (SAMUEL) AND CO., LTD., London, E.C., paper makers. Registered March 26, £550, £550, £550 and £550 mortgages, to Borough of Watford; charged on 39, 41, 43 and 51 Sandringham Road, Watford. *£12,000. May 15, 1924.

PENRICE CHINA CLAY CO., LTD., Hayle. Registered April 24, £500 debentures, balance of £3,000; general charge. *£2,500. March 25, 1925.

China Clay Exports for April

RETURN showing the exports of China Clay, the produce or manufacture of the United Kingdom from the United Kingdom to each country of destination, registered during the month ended April 30, 1925.

Country of Destination.	Quantity. Tons.	Value. £
Esthonia	548	534
Latvia	450	759
Sweden	332	333
Norway	2,886	3,992
Denmark	1	4
Germany	3,027	7,585
Netherlands	2,423	4,743
Belgium	3,626	6,831
France	3,374	6,080
Spain	1,997	5,143
Italy	2,825	7,746
China	5	19
United States of America	36,271	76,738
Mexico	127	502
Colombia	10	50
Brazil	—	3
Irish Free State	—	2
Bombay *via* other ports	1,677	6,718
Madras	101	402
Bengal	496	1,960
Australia	10	42
Total	60,186	130,186

Tehidy Minerals and China Clay

MR. H. MONTAGUE ROGERS (Chairman), speaking at the annual meeting of Tehidy Minerals, Ltd., at Carn Brea, Cornwall, last month, said: "I think this company is now in a progressively prosperous stage, and I feel justified in saying the results of 1925 will be much in advance of those of 1924." The profit for the year was £7,451, an increase of £5,886 over 1923. The additional profit had been obtained from a considerably increased revenue and diminished expenditure. Halviggan China Clay works, which were purchased from H. D. Pochin and Co., Ltd., in 1921, had been disposed of to the Cornish Kaolin, Ltd. Unfortunately they bought on the eve of the great and unexpected trade slump, but they accepted the position and improved the works, plant and capacity of production. The difference between the total inclusive cost to the company and the price received was £6,807, which had been written off the balance sheet. The company remained the landlords of the clay works, and as lessors they would, no doubt, receive in future a substantial income in dues. The financial position of the company had immensely improved, and was still improving. Referring to China Clay, Mr. Rogers said there was a good demand, although they would like to see it increased. Many of the China Clay companies had had a set-back owing to the collapse of the China Clay Association.

The China Clay Trade Review

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Clay Association Dissolution Aftermath

NINE months' experience of the price-cutting war between the home producers of China Clay is having its effect upon the industry, and is revealing a position of much seriousness among the producers of medium and common clays particularly. This will eventually lead to financial ruin or the formation of a new association for mutual protection. In the past few months there has been arising in the ranks of the producers, as well as from among others less directly interested, a feeling that something ought soon to be done to bring all producers to a frame of mind to consider the causes of the present suicidal policy or lack of policy, and to attempt to produce some workable scheme by which the interests of the whole industry could be conserved and the interests of all individual producers safeguarded.

The remarks made by Mr. C. Algernon Moreing, whose companies' China Clay interests in Tehidy Minerals, Ltd., and Cornish Kaolin, Ltd., are large, both as royalty owners and producers of China Clay, are significant, following as they do upon those recently publicly made by Mr. Walter Sessions, joint managing director of English China Clays, Ltd., and of Mr. Wm. Rose, of North and Rose, and also by those less publicly made by the heads of several other firms. The opinions show that the industry is beginning to awaken to the folly of allowing the present sapping process to continue to the detriment of the producers of China Clay and to the tremendous advantage of the users of the commodity. The discussion of the question has been from various angles, and the suggestions made as to the best way of dealing with the problem have been varied, but there is one point on which all are agreed, and that is that some organisation is needed, by means of an association, or otherwise, to protect the industry as a whole. To the outsider, the present spectacle of producers fighting among themselves and impoverishing their resources for the benefit of consumers, who were previously making big profits and are now making handsome ones, is Gilbertian.

To the insider, who is beginning to find the pace too hot, it is tragic, because of the effect it may eventually have upon his financial resources. Unless the producers are prepared to come together to remedy the present evil, the prospect is that the producer relying upon the sale of common clays only, will have to retire from the race and leave the field to the producers who are not so handicapped. While the producers of best clays are able, through their association, to counteract to some extent their losses in the common clay market, it is a welcome sign that they are as willing to consider a new basis of operation as many of the common clay producers are anxious to do. The weakness of the old association was that it depended upon the voluntary disposition of its members to observe its rules, instead of upon the authority of the association to enforce them by law. Consequently they were frequently broken, sometimes openly and sometimes stealthily, while some who did not break them made individual demands as a condition of compliance that caused resentment among those members who were prepared loyally to observe the conditions of membership. Producers must take steps to prevent the present serious menace caused by haphazard price cutting. A process of exhaustion such as that suggested by Mr. Moreing may eventually have its fatal effect upon companies having limited financial resources, but it certainly will not upon the stronger companies that are not wholly dependent upon the common grades of clay. Seeing that these stronger companies are not unwilling to explore the question of a new organisation for the safeguarding of the industry, there should be no delay in arranging a meeting of all the producers to see whether a common basis of operation is possible of achievement. In the meantime, producers who have proposals to make as to how the object they have in view can be attained, should formulate them. For complete success, unanimity is essential, but should this not be possible at the outset, means might be found whereby this might be secured eventually, if the overwhelming majority of the producers were of the same mind. That the time is ripe for a move to be made in the direction indicated, no one who realises the serious effects of the price war that has been going on since the old association broke up nine months ago, can doubt.

China Clay Producers' Inadaptability

SOME time ago Dr. N. R. Ormandy criticised the producers of English China Clays rather severely in a lecture, and showed how the Germans had developed their own resources because the English producers would not or could not supply the right kind of clay for the German manufacturers of hard porcelain.

The result of investigations proved that it was definitely possible from any pottery clay found in England, by the separation of an amount of the impurities, varying from 7 to 20 per cent., to leave a residue which was equal to the Austrian China Clay so far as regarded its possibility of being used for the manufacture of hard porcelain. But did anyone imagine that that was likely to interest the English clay people? Not a bit of it. The China Clay producers' position was this: "If we take 10 or 20 per cent. out of this material which we can sell as it is for so much a ton, shall we get as much extra for what is left behind as will pay us for throwing out this percentage? If not, we shall not do it. If you will go to the people in the Potteries and persuade them that it is worth their while to give us a few shillings a ton more in order to get a really good China Clay, which is nothing but China Clay, then we will do it." The Potteries people, on the other hand, said: "If the people in Cornwall will send us the right kind of clay we will test it and let them know the value of it." And so, as Englishmen, we stood still, while the German developed and perfected his researches, became known and recognised as the maker of hard porcelain for the whole of the world's markets, and sent out something like a million pounds' worth of pottery insulation material annually to this country, to America and to numerous other parts of the civilised world. The knowledge that it was possible to get from our English China Clay fields a China Clay equal to that of Germany for hard porcelain making, and superior to it as regards colour, should be of no small interest to English manufacturers.

Since these remarks were made a great advance has been made by China Clay producers studying the particular requirements of different trades.

The China Clay Price War

Possibilities of a New Producers' Association

At the ordinary general meeting of the Sons of Gwalia, Ltd., on June 8, Mr. C. Algernon Moreing, the chairman of the company, who presided, referred to the company's interests in the China Clay industry, and spoke at some length on the effects of the price-cutting that has followed the dissolution of the Producers' Association. He pointed out the need for a new organisation to safeguard the industry.

Owning nearly the whole of the shares of Cornish Kaolin, Ltd., said Mr. Moreing, they had steadily set their faces against exhausting their property and providing the foreigner with clays without profit to themselves. They felt that such valuable material should not be thrown away, and preferred to allow other concerns in Cornwall to exhaust their properties and dispose of their products without profit, and to conserve their pits and await the reaction which must take place when those owners had either exhausted their resources or their pits and then to step into the market when reasonable prices were again reached—which state was inevitable.

They had ample resources to carry out this policy, and were only selling sufficient clay at the present time to keep all their pits and dries in working order and pay the standing charges. The moment prices became profitable they could extend their production to the full capacity.

The O'd Association's Failure

Previous to 1917 the China Clay trade was in a very depressed condition, similar to and even worse than what it was at present. In that year the Associated China Clays, Ltd., was created and consisted of a majority of the producers in Devon and Cornwall. Amongst other things it was the aim of the Association to act defensively in the interests of both capital and labour, and prevent, by the regulation of output and price, such combinations on the part of buyers as must seriously injure the industry—the buyers, of course, being the foreigners. This Association operated for several years with a considerable amount of success, but towards the end of 1923 and the early part of 1924 a number of members became dissatisfied with existing conditions, and this dissatisfaction became more pronounced as the year passed, with the result that the Association disbanded in September, 1924.

Such an Association must be essentially of a mutual nature, and when dissatisfaction, on any ground, grows to a certain degree, its benefits must cease and its operations end. It was admittedly difficult to provide for the very varied interests of many producers, large and small, in a full and equitable manner, but the experience of the working of the late Association provides the basis for a few comments which he desired to make from a constructive standpoint.

In determining each producer's portion of the trade his works capacity was taken as a basis, and this was measured mainly by the capacity of his dries. This was probably the most satisfactory basis, subject to proportional pit and plant capacity, but unfortunately in a number of cases producers benefited by the inclusion of obsolete dries—the so-called "dud" dries—which had turned out no clay for many a year, and were held solely for allotment inflation. The only fair starting point for a mutual Association must be on actual and not fictitious capacity.

Again, as happened in many industries, amalgamations of a number of works occurred and the joint allotments were thus consolidated or pooled. A large producer could, therefore, if trade were dull in common clay, ease his production of that class and transfer the allotment to higher and more profitable grades, while the producer with one pit producing medium or common clay had no such option.

Price Adjustment Difficulties

One of the most difficult functions of the late Association was the adjustment of the prices at which different producers could sell their varying qualities. This work was carried out by a sampling Committee appointed by the Association and consisting largely of producers who were frequently producing brands competitive with those before them for assessment. Whilst on the whole those gentlemen carried out their difficult duties without any bias, it would have inspired more confidence if their labours had been supported by an entirely independent court of appeal.

The Association was hampered in its operation by the competition of certain outside producers, who, by quoting a little under Association prices, ran their works at full output whilst members proportionately suffered. This menace became so acute that members asked for permission specially to meet this portion of the trade. The Association, however considered that its articles did not provide for this, but Mr. Moreing believed that, had they taken some definite action in that direction, however imperfect such action might have been, its disbandment would not have occurred.

Prices Drop after Dissolution

Following the disbanding of the Association in September last there had been a period of the keenest competition in medium and common clays, and on the production of all grades the prices had dropped on the average at least 5s. per ton, which was equivalent to a net annual loss of a quarter of a million pounds—a gift, in the main, to our American friends, and a loss to this country. This average drop of 5s. had not been uniform. Best clays had nearly maintained their price, medium clays had dropped some 5s., whilst common clays had dropped a full 10s. or more. Trade so far did not show any appreciable increase in quantity following such reductions in price, and it was unlikely that any such increase would in the near future compensate for the enormous discrepancy in revenue referred to.

It might be said that many sales of low-grade clays had been made in recent months at figures below the all-in cost of production, but the directors of Cornish Kaolin, Ltd., had steadfastly resisted the efforts of buyers to increase competition further by voluntarily restricting their output to the bare minimum necessary to keep the pits, plant, and dries in good working order.

Rubber Scheme Applied to China Clay

It was interesting in this connection to note the operation of the Stevenson Restriction Scheme, as applied to the production of rubber, the greater portion of the world's production, like that of China Clay, being consumed in America. When this scheme was framed the market price was depressingly low, being well under 1s. per lb., and almost identical with, and in many cases below, the all-in cost of production, a condition not unlike that of medium and common China Clays to-day, and stocks were alarmingly high. This scheme had in view the establishment of an economic price which would allow a reasonable profit to the producer, and its operation had resulted in maintaining for two years ending October 31, 1924, an average price of 1s. 2d. per lb., and a reduction of London stocks, which a year ago stood at 51,500 tons, to under 5,700 tons.

The scheme commenced on export quota at 60 per cent. of productive capacity, as assessed by Government control, and provided for quarterly adjustments of export quota subject to rise or fall in average price, having in view an average figure of 1s. 3d. to 1s. 6d. per lb. Should the quarterly average equal or exceed 1s. 6d. then the rate of quarterly increase of export quota was doubled. This latter feature was a very wise provision for the protection of the consumer, and brings the operation of the scheme closely into line with the natural laws of supply and demand, although, as was the case at present, it might take a few months to adjust itself. The present price of rubber was 3s. 3d. per lb. and the stocks were at a minimum, showing the complete success of the scheme. The scheme differed essentially from that of the Associated China Clays, Ltd., in that it determined only the quantity each producer could market and left the producer free to sell at the best price he could get. If, then, producers sold at prices under 1s. 3d. the effect would generally be a reduction in the next quarter's tonnage. The condition of the two trades also differed in that the China Clay producer sold his product direct to merchants or consumers at merchants' or consumers' prices as fixed by the Association, whilst rubber was sold by brokers, and sales are regularly published. Again, the provisions of the rubber scheme were enforceable by legislation operating through control of exports with penalties for over-export, whilst the late China Clay Association's operations were based entirely on mutual support.

Possibility of New Association

It might be that the method adopted as to price by the rubber producers was applicable with certain amendments to China Clay, which product had a wider range of qualities and prices than rubber. It could be, as was done in the past, classified in three grades. Average prices could be fixed for the three classes and outputs made adjustable according to the maintenance or otherwise of average quarterly prices. Whether this was the better method or not, Mr. Moreing was satisfied that the time was not far distant when producers would have to take steps to protect their interests. There were indications in different quarters that the time for action had come, and he must emphasise the necessity for producers benefiting by past experience and eliminating from any contemplated Association such features of the old as were unworkable or developed dissatisfaction amongst members. The starting point must be actual productive capacity of members. Prices, if the old method was followed, must be assessed in a way calculated to give producers the fullest confidence in the Association and the Association must be prepared to take steps to meet outside competition where it was operating unfairly. The old Association, up to a point, operated advantageously, and with the incorporating of the above provisos and such others as a full and considered review of present-day conditions would disclose, he was confident that the formation of a new Association would be of benefit to the producers, to labour, and to the country at large.

Progress of the Skip-Waggon
By China Clay "Captain"

VISITORS to the clay mining area cannot but notice the skip-waggon racing up and down the incline, and as they see it reach the top of sand or burden bank, discharge its load and speed away back for another. As they note the automatic opening and shutting of the door, with no one to be seen, save perhaps the signal-bell boy peeping out of his rough shelter, they may wonder how it is done.

For their enlightenment let me say that a great deal of thought and practical experience are concentrated in the latest type of skip-waggon. The experienced clay-" cappen " knows that if he has to get his estimated quota of clay for any given period, he must have a " way out " for his sand and over-burthen, and as it has in most works to go over the incline-road in the " skip," it is of the utmost importance that it should be the best obtainable, it should be durable and reliable, simple yet effective and, as far as possible, fool-proof. This state has not been obtained all at once, and if I go over some of the steps of progress it may be of interest, particularly to the younger generation in the industry.

The alteration in shape is worthy of note. When I first knew anything about skips, they were all invariably rhomboidal (taking the side in elevation), and a few old-timers still survive. These were real *tipping*-skips, the butt swung by hang-bows on the frame. When the catch was released the butt tipped upside down and emptied out the load, being so balanced that when the load was gone it sprang back into position again.

The tipper in the earlier waggons was a piece of wood about 4 in. square and 3 ft. long, pivoted in the centre on the principle of the first order of levers, the top end supporting the lip of the skip. When it reached the top a blow on the bottom end with a large wooden mallet released the top end and caused the butt to tip. These appliances were followed by different sorts of iron catches, and when automatic tippers became necessary some ingenious smith designed a very efficient shaped tipper worked with an arm striking a " joey."

Soon after that the " flying-tips " came into vogue and the shape of the skip changed from a rhomboid to a triangle. If there is any blame or fame for helping to bring this about, I plead guilty to being one of the pioneers, as I drew the plan for the first V-shaped skip, although the idea came from my brother.

The First V-shaped Skip

It came about in this way. I had designed an automatic discharging skip retaining the old shape, but instead of it swinging upside down to tip I built the butt on the frame and had a hinged steel-plate bottom which, dropping down when the catch was released, instantly discharged the load. On the return journey the swinging door, coming into contact with a piece of wood suitably bevelled, was lifted up into position, the bottom edge of door sliding up over bevelled-nose catches automatically to fasten itself. Thus it was away back for another load without any appreciable delay. This waggon went along famously for a time, beating all speed records for discharging until, having the misfortune to get off the track through there being a bad tramway, it bent the door and, failing sometimes to function—being a new thing—it was thrown out and voted as " a very good plan that wouldn't *always* act."

Being younger then, I was naturally disheartened and almost vowed to leave skip-waggons severely alone for the future. But my brother said that my idea was sound ! He said that it was much better to have a door to open than a butt to tip, as the skip could be built stronger and the load discharged with less clearance. Where I failed, he said, was in placing the door at the bottom where, if it accidentally unfastened or the skip went off the track it would get damaged and then fail to work.

" But," I said, " where else can one put a door but at the bottom ? The load will not fall out if I put it on the side ! "

" Yes, it will," he said, " only the butt must be triangular in section instead of a rhomboid."

So I drew the plan accordingly, and if imitation is the sincerest form of flattery, my brother and I ought to feel flattered, for practically every China Clay work in Cornwall and Devon has followed our scheme. Many improvements have been made in construction since then ; we made the skip of wood except the door, now it is made almost entirely of steel-plate and angle-iron. The tipper also has undergone various modifications adapted to suit the varied incline angles, and to work easily some have rollers on the end of closing arms, while the latest type has a compound knuckle and toggle joint in the centre of the arms designed to absorb shock and to give the maximum clearance of door-opening within the frame.

As I have written before, those who have helped to make the skip the undoubted success that it is, do not claim that it is the acme of perfection, but worked as the centre of that remarkable quintette :—" Patent pit "—" Expert sandmen " —" SKIP "—" Flying tip "—" Powerful well-handled Winder " —it is something very near it anyway. It is the fastest and most economical contrivance yet evolved for removing sand. For hauling " stent " in the lump another kind is coming into fashion—a lilting-table arrangement—but more of that some other time.

Fusion of Scottish Paper Makers

AT a recent meeting in Edinburgh of the shareholders of Annandale and Son (Ltd.), Polton Paper Mills, it was announced that shareholders representing 51,000 ordinary shares out of a total issued of 60,000 had agreed to accept the offer to purchase at par their shares on behalf of the Inveresk Paper Co.

The issued capital of Annandale and Son, in addition to the ordinary shares named above, consists of £50,000 5 per cent. Cumulative Preference shares. The present company was incorporated in 1899 to take over a private concern registered in 1886. Mr. J. A. Hood is the chairman of directors. A dividend of 4 per cent. was paid on the ordinary shares for 1923. The paid-up capital of the Inveresk Co. is £250,000 in equal portions of 8 per cent. cumulative preference and ordinary shares. They own 111,333 £1 ordinary shares of the Carringrove Paper Co. Mr. W. Harrison is the chairman of directors, and the works are at Musselburgh. The dividend on the ordinary shares was 12½ per cent. for the thirteen months ended October 31, 1924, and 10 per cent. was paid for the preceding year.

New Australian Paper Pulp Industry

CHINA CLAY producers will note with interest the statement by the Premier of Tasmania (Mr. J. Lyons) that the paper pulp industry will be established at Burnie this year, and there is every reason to believe that a start will be made with the construction of the works within a few months. At the present time Mr. David Avery, director of the Amalgamated Zinc Co., is in Australia after having conducted experiments in the manufacture of paper and pulp from Tasmanian timbers, and he is accompanied by an expert to supervise the construction of the works.

China Clay Notes and News

New Honour for St. Austell China Clay Merchant

Mr. John W. Higman, St. Austell, one of the oldest Freemasons of Peace and Harmony Lodge, in addition to his honour of Past Grand Standard Bearer in Supreme Grand Chapter of Royal Arch Masons, was recently invested at the Grand Lodge Festival of Freemasonry as Assistant Grand Director of Ceremonies for the year. Mr. Higman is also Provincial Steward for Cornwall for the Masonic Peace Memorial Fund. The meeting takes place at Olympia on August 8, when the Grand Master His Royal Highness the Duke of Connaught will preside over a company estimated at 8,000 Masons.

India as a China Clay Market

In the course of a lecture on India to the St. Austell Rotary Club, Mr. George Pilcher, M.P. (Penryn-Falmouth Division), spoke of the great value of that country as an outlet for our exports, and remarked that China Clay producers should be interested because of the expanding possibilities of the Indian market for China Clay and for the cotton goods of Lancashire, in which China Clay is used as a filler and bleacher.

Rotarian E. J. Hancock (West Carclaze China Clay Co., Ltd.) referred to the potentialities of the country as a market for China Clay, the demands for which would increase as the mode of life improved and as the anti-British co-operative movement became less aggressive. When the Gandhi agitation was at its height, he said, there was a wholesale cancelling of orders for China Clay and in consequence the market fell off considerably.

Fowey Harriers' New Officers

At a general meeting of Fowey Harriers at St. Austell, Mr. J. de C. Treffry, retiring master, presiding, Mr. W. Treffry, the hon. Secretary and Treasurer, reported that Lady Vivian and Miss Ivy Martyn had accepted the position of joint Masters of the Hunt for the year. In view of their satisfactory financial position (£150 had been raised), it was agreed that no guarantee fund was necessary this year. On the recommendation of the Committee it was agreed that Mr. J. Hoyle, who is a director of Manchester China Clay Co., Ltd., be Joint Secretary and Treasurer with Mr. Treffry. The following were added to the Committee: Lord Vivian, Sir James Hope Nelson, Gen. Sir Frederick Poole, Major J. de C. Treffry, Colonel E. Treffry, Major G. H. Johnstone, Mr. W. Kendall King, Mr. W. Littleton, Mr. J. Nankivell, and a representative of the Bodmin D.C.L.I. Officers' Mess.

New Rating Bill Opposed

At a conference at St. Austell of representatives of assessment committees, overseers, and others interested in the subject of rating and valuation throughout the China Clay district, the Rating and Valuation Bill was explained by Mr. F. H. Smith, clerk to the St. Austell Rural District Council and Guardians. He said that the Bill revolutionised valuation and rating in the country, and it would not be the agreed measure that the Government hoped when they started circulating it. One consolidated rate was to be made in all rating areas other than rural districts. In the latter the poor rate now made in respect of each parish, was to be superseded by a general rate over the whole district, the special expenses rate remaining as at present. County Council precepts, instead of being sent to the Guardians, were to be sent to the rating authority. Their precepts as well as those of the Board of Guardians, instead of calling up so much money, would be sent to the rating authority, and would state what rate was required from the rating area.

Rating of Machinery

The second part of the Bill dealt with valuation. It provided that county boroughs should be valuation areas in themselves with assessments committees, and that other areas should be set up, with a County Valuation Committee to promote uniformity in the principles and practice of valuation. It was proposed to rate machinery which formed part of hereditaments, but to exclude process machinery and loose tools and plant. A standing committee of county justices would have all the powers of the Quarter Sessions to deal with the rating appeals, and notwithstanding that an appeal might be in respect of gross value only, or rateable only, the Quarter Sessions might treat the appeal as if it was in respect of both valuations, and might either increase or reduce the valuations. The Bill provided for compensation for officials who were displaced, and overseers would cease to be appointed, and their powers transferred to the rating authorities, and their non-rating functions transferred to other local authorities. Assessment committees would be appointed for each valuation area, and would comprise members of the Town Council, Urban Council, Rural Council, Board of Guardians, and the County Council, two at least of whom must be commissioners of income tax.

Less Drastic Measures Called For

Criticism of the Bill had been fairly strong. Everybody considered some measure of reform was needed, but all were convinced that reform could be obtained by less drastic proposals. One thing quite certain was that the change-over to the new system, involving abolition of office in numerous cases, appointment of additional staff in others, and the payment of compensation, would result in heavy additional expenditure. It was complained that the Bill was designed more for income-tax purposes than rating, and that revenue officials were given too much power, whilst the power of local committees was minimised.

Replying to Mr. F. Dempster, Mr. Smith said that he did not think the revision of the rating of machinery would affect that district very much, but it greatly affected industrial areas who were asking for their support in the matter of resisting it. The object of the Bill was to create uniformity, but the effect would be to create offices.

The following resolution in opposition to the Bill was passed: "This conference of assessment committees, overseers, and others interested in the question of rating in St. Austell district heartily approves of the letter forwarded by Mr. Thomas White, chairman of the National Conference of Assessment Committees of England and Wales, to the Members of Parliament on May 9, and while convinced that the time has come for rearranging rating and valuation organisation in the country, strongly supports the protest against the Rating and Valuation Bill put forward by the National Conference of the Assessment Committees."

China Clay Worker's £600 Compensation

At St. Austell County Court before Judge Gurdon, Mr. J. C. Hubbard made an application arising out of the payment into Court of £600 by H. D. Pochin and Co., Ltd., being compensation in respect of the death by accident on Good Friday, through the fall of debris, of Robert Stanley Gatheridge, 36, of Penwithick, while in their employ in the clay pit.

On behalf of the young widow, who is left with three young children, it was stated that the £600 was the maximum amount to which the widow was entitled. She asked for the payment of a lump sum of £70, and instalments of £2 per week for the maintenance of herself and children. John Hancock, father of the widow, said the deceased's average weekly wage was £2 1s. 8d.

His Honour suggested that the widow should make do on less than £2 per week because at that rate the money would be exhausted in a little over five years. In response to His Honour's suggestion the widow agreed to try to make 30s. per week sufficient. His Honour made an order accordingly, and agreed to the investment of £400 in 5 per cent. war stock, the balance to be put in the Post Office.

Further Electrification of Clay Works

English China Clays, Ltd., are making further extensions in the electrification of their works by equipping those at Dubbers and Dorothy at St. Stephens, in the St. Austell district. For a great number of years the Cornish steam engine has provided the power at these works. With the change over to electricity the capacity of the pumping and winding machinery have been greatly increased. In order to increase the productive and storage capacity of these works, new runs of micas are being constructed, as well as large settling pits. In two other directions the company are adding to their works. At Stannon in North Cornwall their double run of

pipe-line has been diverted for a distance of three miles, and a large filter press has been installed. After a series of experiments their works manager, Mr. Alfred Davies, has proved the efficiency of the filter press system of extracting the moisture from the clay and preparing it for the kilns. Consequently the company are extending this process to a number of their works. Both in the speed with which the clay can be dealt with and in the economy effected in coal consumption, results have proved very satisfactory. At their china stone grinding mills at Ponts Mill, St. Blazey, extensions are also in progress.

Growth of St. Dennis

The former China Clay village of St. Dennis has during the last few years developed into a small town, and as a growing community the people of the place feel the need for speeding up its administration. They have not yet taken steps to secure urban powers, but they have now obtained the St. Austell Rural Council's agreement to the setting up of a parochial committee, formed of representatives of the Rural and Parish Councils, to act as a kind of liaison between the two bodies. Mr. R. Hooper (works manager for H. D. Pochin and Co., Ltd.), who is one of the oldest members of the Rural Council, sponsored the proposal at the Rural Council meeting. He pointed out that the object was to give those concerned in the parish the medium for dealing with all matters pertaining to the parish, discuss them, and send recommendations to that Council either to adopt or turn down as they thought fit. He thought it would greatly facilitate the business of that Council if a committee such as that were appointed. If all local schemes were brought forward for which the parish concerned had to find the money, surely the parishioners or their representatives were entitled to say how it should be spent. If bigger schemes were brought forward and the expense borne by the Council, certainly the Council should say how the money should be spent.

Pottery Exports Up

In connection with the export of pottery from the United Kingdom, the totals for the first quarter of the present year are considerably higher than those of the first quarter of 1924. All the overseas countries, with the exception only of the United States and the Argentine Republic, have taken larger quantities of British pottery, many of these countries having made demands which were very considerably in excess of the previous figure. The increase applies to all kinds of materials included under the general heading of pottery, but is most marked in the materials made for the electrical trades, where the export figures are almost double. The Canadian imports of pottery and clay products amounted to 3½ million dollars for the twelve months' period ending on the last day of February, 1925, and of this total nearly 2½ million dollars was accounted for by the import of British china table ware.

In the Eastern States of America the British pottery which is sold so successfully is principally of the highest quality, while in the Western States large quantities of high quality goods and smaller quantities of medium quality goods from Britain are in demand. There has been a steady increase in the quantity of all kinds of pottery exported from Britain to the United States during the past few years, and this increase in total values is all the more notable in that it represents a much greater corresponding increase in the quantities shipped, as during the period the prices of British pottery have considerably decreased. British pottery is purchased in America because it is of higher quality than that obtained from the home or other countries. Design and quality are the chief factors which are taken into consideration.

New Patent for Using Clay

230,248. Firebricks, crucibles, or like articles required to withstand high temperatures. F. W. Cobb, 19, Holyhead Road, Handsworth, Birmingham.

This invention has for its object an improved composition whereby the firebrick, crucible, or the like will withstand high temperatures without melting or without cracking when subsequently cooled. The material of which the required articles are moulded comprises fireclay and ground pebble. The pebble is obtained from sand beds and is ground to dust or to particles of a size which will pass through a 20 mesh sieve, and the fireclay is of a plastic or sticky nature in order that the ground pebble can be mixed therewith to form a binding and so that the mixture can be moulded without cracking. The proportions are one part fireclay to two parts of ground pebble. The ground pebble gives the moulded article a porous character which allows the interior to dry when the articles are fired in the process of manufacture. Again, the porous character allows the articles to cool more evenly when in use and thus prevent cracking. The ground pebble also gives a higher melting temperature to the clay. The pebble before being ground is in its natural form obtained from the sand beds and comprises pebble mainly comprised of quartz, with which is found in the sand beds, limestone pebble, volcanic ash pebble, and sandstone pebble. If desired, ground tessara may be included in the mixture, the particles of the tessara being ground to a size as is the case with the pebble. The tessara comprises such material as waste tiles, which are made of burnt China Clay and ball clay. The composition comprises three parts fireclay, four parts ground pebble, and one part ground tessara.

St. Austell China Clay Merchants at Golf

The Captain's (Mr. Keay) prize at St. Austell was played for by match under handicap with the following results:—*First Round*—T. Tregunna (10) bt. T. C. Ellis (14), 4 and 3; J. P. Carter (8) bt. A. Davies (13), 2 up; F. Pettifer (10) bt. P. S. Barry (24), 6 and 5; G. M. Johnson (18) bt. H. Beer (15), 2 up; Dr. Moore (15) bt. Major Coode (18), 2 and 1; E. H. Fryatt (9) bt. H. E. Warne (13), 3 and 1; W. H. Hitchins (10), Dr. Shaw (15), R. J. Varcoe (11), J. R. Gaved (17), S. Smith (18) walks over; R. J. Hore (23), Dr. Olver (18), Com. E. Stocker (16), W. Craig (24), and A. Horne (9), byes.

Second Round—Com. Stocker beat W. H. Hitchins, 5 and 3; R. J. Varcoe bt. Dr. Shaw, 3 and 2; J. P. Carter bt. T. Tregunna, 2 and 1; F. Pettifer bt. J. R. Gaved, 2 up; G. M. Johnson bt. Dr. Moore, 3 and 2; E. H. Fryatt bt. S. Smith, 4 and 3; A. Horne bt. W. Craig, 6 and 4; R. J. Hore, walk over; Dr. Olver, scratched.

Third Round—R. J. Hore bt. Commander Stocker, 6 and 4; J. P. Carter bt. R. J. Varcoe, 2 and 1; F. Pettifer bt. G. M. Johnson, 2 up; A. Horne bt. E. H. Fryatt, 3 and 2.

Semi-final—J. P. Carter bt. R. J. Hore, 3 and 2; A. Horne bt. F. Pettifer, 4 and 2. *Final* (36 holes)—A. Horne bt. J. P. Carter, 4 and 2.

Mr. Horne, the winner, is on the staff of English China Clays, Ltd., and Mr. Carter, the runner-up, is a partner in the China Clay shipping firm of Toyne Carter and Co., Ltd., at Fowey.

On behalf of the Captain, Mrs. A. Shaw, who is a sister of Mr. T. Medland Stocker, of English China Clays, Ltd., presented the prize, a silver cup, to Mr. Horne. In reply to a vote of thanks, Mr. Keay thanked Mrs. Shaw for her help, and the Hon. Secretary, Capt. J. B. King, for arranging the competition for the prize.

Fowey £ 6,000 Housing Scheme

Fowey Borough Council is about to embark on a £16,000 housing scheme for the provision of houses mainly to meet the needs of men employed on the China Clay jetties who have now to travel by train backwards and forwards to their work.

Alderman Lewarne, chairman of the Housing committee, said at the last Council meeting that they had adopted a site, and the Committee hoped now that the Council would adopt the scheme. They recommended the Council not to go in for the Wheatley Scheme, but to adopt the Chamberlain scheme on the basis of £6 subsidy per annum for 20 years. The proposed houses would be built of concrete blocks cemented up to the first floor, and the upper part to be roughly coated. They would comprise living room, scullery, larder and bathroom on the ground floor, with cooking range in the scullery, and three bedrooms on the first floor. They would be built in blocks—16 at the front of the site, and 16 at the back—provided the Ministry of Health sanctioned the building of 16 houses to the acre. The estimated cost per house, allowing for laying drains, roads, and providing water, was £475. If the Ministry of Health did not allow them to build 16 to the acre, they might not put up more than 12 to the acre, which would place the cost per house at a higher figure with an increased ground rent, but it was hoped that such houses could be let at about 9s. per week.

The clerk, Mr. H. S. Graham, said that the Council could borrow the money and would get back from the Ministry of

Health a subsidy of £6 per house per annum for 20 years, irrespective of the amount of rent that would be charged.

Councillor Mitchell explained that under the Chamberlain scheme they could charge what rent they liked. If the cost was the figure estimated, and in his opinion they should be able to build at that figure and it had been done in other places, they could let the houses at 9s. per week without any expense falling on the rates. It was for this reason the Council was asked to adopt the present scheme.

Ceramic Society's President on Research

In the course of his presidential address at the annual meeting of the Ceramic Society at Stoke-on-Trent last month, Mr. Albert G. Richardson said that the need for research in pottery production was greater to-day than ever. The difficulties of pottery manufacturers appeared to become greater in number instead of less, or was it that a higher general standard was demanded and economic conditions were compelling greater efficiency and less loss? There were also new fields to enter and new adventures into the unknown, in every phase of ceramics. The variations in pottery materials rendered the efficient manufacture of pottery a difficult proposition. The raw materials were particularly troublesome, e.g., ball clay, China Clay, flint, stone, felspar, fireclay, saggar clay, etc. And, seeing the potter had no means to hand at the moment of standardising the properties of each of these materials, there was plenty of scope for scientific investigation concerning the classification of the various effects developed by the varying compositions and the varying physical properties of these and other materials.

In the general processes of manufacture there did not seem to have arisen anything of special note, but there were still many difficulties to overcome in the use of alkaline slips. These appeared to be on the increase rather than diminishing, though it would seem in many cases that a better article would be produced by the jolley at a comparative price. In the use of alkalin casting slips there was still some trouble with pinholes, and problems still required to be solved in connection with varying fluidities, variations in the time of casting up, etc. The numerous causes of such troubles had still to be made clear and defined. It would also be an advantage to investigate the best uses which could be made of scraps of waste clay in the production of this type of casting slip, and the best treatment to adopt to obtain a slip which did not possess the detrimental properties before mentioned. Research might also be undertaken into the possibility of making casting slip from raw materials, particularly as difficulties might arise as to the refining of the various materials.

Growth of U.S.A. Pottery Industry

Although the expansion of the pottery industry in the United States has been comparatively recent, says the National Bank of Commerce, in a New York report quoted in *The Board of Trade Journal*, from the standpoint of value of output the country has taken the leading place among pottery producing nations. The domestic industry has been developed on the basis of adequate supplies of domestic clays suitable for many pottery products, abundant supplies of fuel—which is a large item in production cost—competent skilled labour, and a broad domestic demand for pottery products. This last factor has been probably the greatest incentive toward developing the industry in the United States. Apparently there was a real expansion in volume between 1919 and 1923. During this period the greatest increases were made in the manufacture of sanitary ware, white ware, and porcelain electrical supplies. White ware comprises the general household wares, and constitutes more than one-third the value of all pottery. Some expansion occurred in the output of red earthenware, stoneware, and cooking ware. Hotel china was not reported separately prior to 1921, but in that year production was valued at 7,888,000 dollars. This pottery declined to 6,966,000 dollars in 1922, but in 1923 amounted to 9,754,000 dollars. The leading States producing pottery are Ohio, New Jersey, West Virginia, New York, and Pennsylvania. Pottery manufacturing is also established on an industrial basis, although on a very limited scale, in a majority of the remaining States. Since the establishment of the industry there has been more or less competition in the export markets between the five leading producing countries, Germany, France, United Kingdom, Japan, and the United States. While the United States is the largest producer of pottery, it is also the largest consumer. A survey of total exports of all kinds of pottery from Germany, France, United Kingdom, and Japan indicates that exports in 1924 by those countries were but little greater in the aggregate than exports in 1913. It is apparent, therefore, concludes the report, that foreign competition is not of sufficient magnitude to curtail the development of the pottery industry in the United States.

Fowey Stevedores' Regatta Rivalry

Crowds of holiday makers from all parts made their way by means of train, 'bus, motor-car, and cycle to Fowey on Whit-Monday, the principal attraction being the Annual Regatta of the Fowey G.W.R. Stevedores, the competitors being mainly jettymen employed on the China Clay jetties. Great enthusiasm was displayed over the four-oared races, and much rivalry prevailed between the crews of the various boats. The popularity of these events was rivalled by a ladies' race, the principal open men's race, jettymen's race, boys' race, and an extra four-oared event at the end. The premier event was the four-oared race, Class A, open to all comers, which was rowed over a hard course of about five miles. There were four starters: the "Challenge" (Fowey), "Defiance" (Polruan), "Defender" (Polruan), and "Docker" (Fowey). The boats made a fine start, but unfortunately the "Docker" broke an oar early in the race and had to retire. The race then developed into a struggle between the "Defiance" and the "Challenge," the "Challenge," however, maintaining a lead all through, and finishing up first, with the other boat a good second.

The Jettymen's four-oared race was also a well-contested event. There were four starters, but at about the same spot as the "Docker" met with misfortune in the open event, the "Little Beauty" fell foul of the "Defiance," the former breaking a paddle and having to give up. The following are the detailed results:—Four-oared race, Open, 1, "Challenge" (Fowey) (Beswarrick, Robins, C. Pascoe, G. Sullivan); 2, "Defiance" (Polruan) (R. Taylor, Robert Taylor, Ruben Taylor, and L. Crapp); 3, "Defender" (Polruan) (P. Libby, C. Minnear, L. Minnear, F. Lewis). Four-oared race for jettymen—1, "Docker" (S. Luke, J. Cornish, A. Charmen, W. Barbery); 2, "Defender" (A. Simmons, F. Thomas, J. Cornish, R. Tomlin); 3, "Defiance" (Ruben Taylor, Richard Taylor, L. Minnear, L. Crapp). Four-oared race, Boys under 16—1, "Sport" (Butson, C. Tomlin, McLaren, Lewis); 2, "Defender" (Taylor, Crapp, Welsh, Allen); 3, "Docker" (H. Sweet, D. Jago, H. Vincent, W. Grose). Four-oared race, open to non-prize-winners in the other four-oared events—1, "Challenge" (Cowling, Stephens, D. Grose, Webber); 2, "Defender" (Simmons, Minnear, Hicks, Grose); 3, "Sport" (P. Banbury, W. Olsen, L. Tamblyn, E. Curtis).

Clay Convention, Buxton, May, 1925

NEARLY three hundred clay workers representing every phase of the industry attended the Clay Convention at Buxton last month.

The programme included twelve meetings, a conference, and various technical and social functions, including a visit to the works of the Derbyshire Silica Fire Brick Co.

Mr. H. G. Montgomery, hon. secretary of the Institute of Clayworkers, was presented with his portrait in oils on behalf of the industry. He has now seen 33 years' service in the clay industry and is editor of *The British Clayworker*.

Clay Producers Support Ceramic Engineering Course

AT the twenty-third annual meeting of the National Clay Products Association, held at Toronto, it was reported that fifteen leading clay products firms of Canada had signed an agreement agreeing to a voluntary assessment of 30 cents per $100 payroll for a period not exceeding three years to assist in the establishing of a ceramic engineering course at the University of Toronto. President T. H. Graham, Shale Products, Ltd., Inglewood, Ont., in his address stressed the importance of the Association promoting education in ceramics.

American China Clay Tariffs

IT is expected that by next month we shall be in a position to record the action of the Advisory Board of the U.S. Tariff Committee in connection with the China Clay investigation that has recently been made by experts of the Commission.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—May, 1925

Arrival Date	Name	Sailing Date	Destination
May 1,	S.S. *Agate*	May 5,	Weston Point
May 1,	S.S. *Mercurius*	May 5,	Gothenburg
May 1,	M.V. *Michael Kelly*	May 8,	St. Helens, I.O.W.
May 1,	S.S. *San Francisco Maru*	May 15,	Philadelphia
May 2,	S.S. *Orleigh*	May 8,	Rouen
May 2,	M.V. *Lydia Cardell*	May 12,	Aberdeen
May 3,	*Active*	May 16,	Gijon
May 3,	S.S. *Martha*	May 6,	Leith
May 4,	S.S. *Westdale*	May 6,	Birkenhead
May 5,	*Fuglen*	May 18,	Raovmo
May 6,	S.S. *Bangor*	May 9,	Newcastle
May 6,	S.S. *Pylades*	May 9,	Methil
May 7,	*Guiding Star*	May 9,	Charlestown
May 7,	S.S. *Wheatear*	May 8,	Cardiff
May 8,	M.V. *Wigala*	May 14,	Raumo
May 8,	S.S. *Falmouth Castle*	May 12,	Weston Point
May 8,	S.S. *Kilcoher*	May 13,	Antwerp
May 8,	*Amanda*	*	
May 9,	S.S. *Rijnstroom*	May 13,	Amsterdam
May 9,	S.S. *Cornish Trader*	May 12,	Ridham
May 10,	M.V. *Zeeland*	May 14,	Gravelines
May 10,	S.S. *Calcaria*	*	
May 10,	S.S. *Westerham*	May 13,	Runcorn
May 10,	S.S. *Ravenspoint*	May 13,	Genoa
May 11,	M.V. *William Ashburner*	*	Greenhithe
May 11,	S.S. *Dorset Coast*	May 13,	Birkenhead
May 12,	*Waterwitch*	June 9,	Newcastle
May 13,	S.S. *Calluna*	May 18,	Antwerp
May 13,	*John Sims*	May 21,	Ardrossan
May 13,	S.S. *Marena*	May 16,	Gravesend
May 13,	S.S. *Rosten*	May 19,	Kotka
May 13,	S.S. *Norfolk Maru*	May 27,	Boston, Mass.
May 13,	S.S. *Hilda*	May 15,	Hamburg
May 13,	S.S. *Shoreham*	May 16,	Preston
May 13,	S.S. *Moneyspinner*	May 19,	Brussels
May 14,	S.S. *Deneside*	May. 20,	Gravelines
May 14,	*Mary Ann*	May 26,	Newcastle
May 14,	M.V. *Katie*	May 23,	Charlestown
May 15,	S.S. *Felspar*	May 20,	Weston Point
May 15,	S.S. *Claretta*	May 20,	Preston
May 15,	*C. and F. Nurse*	May 29,	Rochester
May 15,	S.S. *Clara Monks*	May 21,	Runcorn
May 16,	M.V. *Dewadden*	May 19,	Looe
May 16,	M.V. *Isabel*	May 19,	Par
May 18,	S.S. *Sandar*	May 19,	Barcelona
May 18,	*Mars*	June 3,	Hamburg
May 18,	S.S. *Yone Maru*	May 29,	Philadelphia
May 18,	S.S. *Elizabeth*	May 21,	Bremen
May 19,	S.S. *Foamville*	May 21,	Runcorn
May 19,	S.S. *Mellanear*	May 23,	Ridham
May 20,	*Zampa*	June 5,	Gefle
May 21,	S.S. *Alice*	May 26,	Preston
May 21,	*Alert*	June 4,	Garston
May 22,	S.S. *Audax*	May 26,	Antwerp
May 22,	S.S. *Falmouth Castle*	May 23,	Garston
May 22,	S.S. *Westdale*	May 26,	Liverpool
May 22,	S.S. *Gouwestroom*	May 30,	Amsterdam
May 23,	S.S. *Avanville*	May 30,	Preston
May 23,	S.S. *Vesla*	May 29,	Montreal
May 23,	S.S. *Jessie Summerfield*	May 28,	Runcorn
May 23,	S.S. *Cornish Trader*	May 28,	Antwerp
May 23,	M.V. *Isabel*	June 2,	London
May 23,	*Pursuit*	*	
May 24,	S.S. *Abercraig*	May 30,	Grimsby
May 24,	*Happy Harry*	June 4,	Garston
May 24,	S.S. *Adam Smith*	May 29,	Weston Point
May 25,	S.S. *Dorset Coast*	May 29,	Birkenhead
May 26,	*Meta*	June 9,	Leith
May 26,	S.S. *Amy Summerfield*	May 29,	Preston
May 26,	*Leader*	June 2,	Gloucester
May 27,	*Fursy*	June 10,	Gijon
May 27,	S.S. *Gertie*	May 30,	Larne
May 27,	*Ada*	June 2,	Bridgwater
May 27,	S.S. *Yewdale*	June 3,	Antwerp
May 27,	S.S. *T. P. Tilling*	May 30,	Fleetwood
May 27,	M.V. *Dewadden*	*	
May 28,	S.S. *Kyanite*	June 2,	Rouen
May 28,	S.S. *San Paolo*	June 5,	Genoa
May 28,	S.S. *Magrix*	June 3,	Gravesend
May 29,	S.S. *Marena*	May 30,	Gravesend
May 29,	S.S. *Baron Sempill*	June 5,	Philadelphia
May 30,	S.S. *Esther*	June 5,	Brussels
May 30,	S.S. *Lochaber*	June 4,	Weston Point
May 30,	S.S. *Blanche*	June 4,	Munkedal
May 30,	S.S. *Poolton*	June 4,	Par
May 30,	S.S. *Norseman*	June 3,	Guernsey
May 31,	S.S. *Jarrix*	June 5,	Antwerp
May 31,	S.S. *Shoreham*	June 6,	Runcorn

* Signifies "In Port."

Charlestown Shipping—May, 1925

Arrivals

Date.	Vessel.	From.
May 1	*Dispatch*	Truro
May 2	*Guiding Star*	Helford
May 4	*Louistic*	Nantes
May 7	*Bonawe*	Plymouth
May 8	*Guiding Star*	Glasgow
May 8	*Bulla*	Penzance
May 8	*Cornish Merchant*	Plymouth
May 9	*Nalan*	Soton
May 12	*Porthleven*	Plymouth
May 15	*Adelaide*	Penryn
May 18	*Britisher*	Newport (I. of W.)
May 19	*Maggie A.*	Falmouth
May 20	*Alberta*	Littlehampton
May 21	*Emily Varbrick*	Par
May 22	*Two Sisters*	Briton Ferry
May 23	*Katie*	Fowey
May 23	*Jolly Frank*	Cardiff
May 25	*Pet*	Falmouth
May 25	*Freighter*	Dartmouth
May 26	*St. Paul*	Perrosqueril (France)

Sailings

Date.	Vessel.	Destination.
May 1	*Greenhithe*	London
May 8	*Dispatch*	Rochester
May 8	*Guiding Star*	Western Point
May 11	*Louistic*	Nantes
May 9	*Bonawe*	Fleetwood
May 9	*Cornish Merchant*	Preston
May 12	*Nalan*	London, Erith
May 13	*Porthleven*	Gravesend
May 14	*Bulla*	London, Dartford
May 19	*Adelaide*	Runcorn
May 19	*Maggie A.*	Tayport
May 20	*Britisher*	London, Dartford
May 22	*Alberta*	Antwerp
May 25	*Emily Varbrick*	Western Point
May 25	*Pet*	Chester
May 26	*Katie*	Rochester
May 26	*Freighter*	Leith
May 27	*Jolly Frank*	Gravesend
May 29	*St. Paul*	Leith

Par Harbour Shipping—May, 1925

Sailings

Date of Sailings.	Vessel's Name.	Destination.
May 1,	S.S. *Edith*	Pentewan
May 6,	S.S. *Fernside*	London
May 8,	M.V. *Irene*	Gloucester
May 9,	S.S. *Treleigh*	Preston
May 8,	S.V. *Hawarden Castle*	Rochester
May 14,	S.V. *Perseverance*	Glasgow
May 14,	M.V. *Regina*	Pentewan
May 14,	S.S. *Edith*	Fowey
May 14,	S.V. *Leading Light*	London
May 14,	S.V. *W. E. Gladstone*	Pentewan
May 19,	S.V. *Hero*	Runcorn
May 19,	S.S. *Deloraine*	Fleetwood
May 21,	S.V. *Conrad Luhring*	Bremen
May 21,	S.S. *Southwell*	Rouen
May 21,	S.S. *Robrix*	Teignmouth
May 21,	S.V. *Emily Warbrick*	Charlestown
May 22,	M.V. *Isabel*	Fowey
May 24,	S.S. *Bruxelles Maritime*	Terneuzen
May 25,	S.S. *Tanny*	Penarth
May 25,	S.S. *Snow Queen*	Fleetwood

May 25, S.S.	*Treleigh*	Preston
May 26, M.V.	*Hope*	Mevagissey
May 26, S.V.	*Yealm*	Pentewan
May 26, S.V.	*Triumph*	Pentewan
May 26, S.V.	*Gwendoline*	Pentewan
May 26, M.V.	*Regina*	Pentewan
May 28, S.V.	*Goldfinch*	Plymouth
May 28, S.S.	*Magrix*	Teignmouth

Arrivals

Date of Arrival.	Vessel's Name.	From.
May 1, S.S.	*Edith*	Plymouth
May 4, S.V.	*Rose*	Charlestown
May 4, S.S.	*Fernside*	Penryn
May 9, S.S.	*Treleigh*	Portreath
May 9, S.V.	*Perseverance*	Falmouth
May 10, S.V.	*Hero*	Falmouth
May 14, M.V.	*Regina*	Plymouth
May 14, S.S.	*Edith*	Plymouth
May 15, S.V.	*W. E. Gladstone*	Plymouth
May 15, S.V.	*Conrad Luhring*	Lanyon
May 15, M.V.	*Hope*	Falmouth
May 15, S.S.	*Deloraine*	Southampton
May 17, S.S.	*Southwell*	Penzance
May 19, M.V.	*Isabel*	Fowey
May 20, S.V.	*Yealm*	Plymouth
May 20, S.V.	*Triumph*	Plymouth
May 20, S.V.	*Gwendoline*	Plymouth
May 20, S.S.	*Robrix*	Truro
May 20, S.V.	*Goldfinch*	Plymouth
May 20, M.V.	*Regina*	Plymouth
May 21, S.S.	*Tanny*	Penzance
May 21, S.S.	*Bruxelles Maritime*	Southampton
May 21, S.S.	*Treleigh*	Cardiff
May 28, S.S.	*Magrix*	Teignmouth

Par Harbour Tide Table, June, 1925

(British Summer Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Saturday	20	5.43	6.4	12.0
Sunday	21	6.25	6.45	12.1
Monday	22	7.4	7.23	12.0
Tuesday	23	7.39	7.56	11.9
Wednesday	24	8.11	8.28	11.4
Thursday	25	8.45	9.2	10.11
Friday	26	9.20	9.37	10.5
Saturday	27	9.56	10.15	10.3
Sunday	28	10.36	10.59	10.1
Monday	29	11.25	11.51	10.0
Tuesday	30	—	0.20	10.1

E. CLEMENS, Harbour Master.

May Deliveries Improve

FOLLOWING the heavy drop in the business shown by China Clay firms in April compared with March, there was a very considerable revival in May, the increased deliveries of China Clay alone amounting to 20,000 tons. There was an increase of 1,000 tons in the china stone deliveries, and 700 tons in the ball clay deliveries. The difference between the total deliveries of all classes in May and April was a little over 23,000 tons. Fowey was wholly responsible for the increase, shipping a total of 72,497 tons in all classes, compared with 49,226 tons in April. The total for the five months this year is 400,468 tons against 368,754 tons for the corresponding five months last year, an increase of 31,714 tons. On the five months, while china stone shows a drop of 1,767 and ball clay a drop of 1,736 tons, China Clay shows an increase of 35,217 tons. This is accounted for by the fact that China Clay is now selling at considerably lower prices than last year, when some consumers were using china stone and ball clay in substitution. This year medium and common clays have been sold at prices which have allowed in many cases very little return to the producers. Details:

Port.	China Clay. Tons. 1925.	1924.	China Stone. Tons. 1925.	1924.	Ball Clay. Tons. 1925.	1924.	Total. Tons. 1925.	1924.
Fowey	66,782	67,414	3,950	2,130	1,765	2,589	72,497	72,133
Charlestown	4,994	3,374	—	—	—	—	4,994	3,374
Par	2,043	3,904	326	1,178	—	—	3,269	5,082
Plymouth	1,614	2,007	10	55	60	—	1,684	2,062
Penzance	345	466	—	—	—	—	345	466
By rail	4,182	5,240	—	—	—	—	4,182	5,240
Totals	80,860	82,405	4,286	3,363	1,825	2,589	86,971	88,357
April	59,624	75,311	3,198	4,651	1,118	2,627	63,940	82,589
March	94,217	74,191	2,526	4,152	1,855	2,297	98,598	80,640
February	66,863	52,244	3,436	1,575	614	1,118	70,913	54,937
January	74,490	56,686	2,506	3,978	3,050	1,567	80,046	62,231
5 months	376,054	340,837	15,952	17,719	8,462	10,198	400,468	368,754

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

BARKER BROTHERS, LTD., Longton, earthenware manufacturers. Registered May 27, £8,000 debentures; general charge. *——. December 31, 1924.

EREWASH PORCELAIN CO., LTD. Registered May 28, debentures, to Bank; general charge.

GREAT ROSEMELLYN CHINA CLAYS, LTD., Exeter. Registered May 5, mortgage, to Bank; charged on various rights, etc., relating to lands, etc., at Roche, with machinery, etc.

RUBIAN ART POTTERY, LTD. (late H. K. BARKER AND CO., LTD.), Fenton. Registered April 30, £1,000 further charge, to Building Society; charged on Rubian Art Pottery, Park Road, Fenton, comprised in mortgage dated October 4, 1922. *£5,500. October 14, 1924.

SOHO POTTERY, LTD., Cobridge. Registered May 26, charge, to Bank; charged on premises at Cobridge. *£4,000. January 14, 1925.

Satisfactions

DRAY (G. W.) AND SON, LTD., London, S.W., paper makers. Satisfaction registered May 20, all moneys, etc., registered April 16, 1914.

FOREST CHINA CLAY WORKS, LTD., London, E.C. Satisfaction registered April 29, £1,000, part of amount registered July 9, 1924.

China Clay Exports for May

RETURN showing the exports of China Clay (including China or Cornish stone), the produce or manufacture of the United Kingdom from the United Kingdom to the countries of destination registered during the month ended May 31, 1925:—

Country of Destination.	China Clay. Quantity. Tons.	Value. £
Russia, North	105	552
Finland	2,970	5,982
Sweden	1,022	1,327
Norway	1,090	1,406
Denmark	1	6
Germany	1,001	2,277
Netherlands	3,026	6,276
Java	100	370
Belgium	2,849	5,350
France	2,974	5,604
Switzerland	14	36
Portugal	18	72
Madeira	9	80
Spain	1,027	2,838
Italy	734	2,221
Roumania	4	15
Turkey-Asia	10	40
Siam	2	10
China	5	19
United States of America	21,448	43,123
Mexico	120	480
Peru	10	45
Chile	4	15
Brazil	5	28
Argentine Republic	—	1
Cape of Good Hope	—	1
Bombay *via* other Ports	1,928	8,261
Madras	40	179
Bengal	350	1,400
Ceylon	25	100
Hong Kong	5	20
Australia	86	445
New Zealand	—	6
Canada	202	626
Irish Free State	17	48
Total	41,201	89,259

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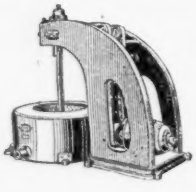

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